THE

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THE

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THE GLASGOW EXHIBITION.

THE opening of the Glasgow Exhibition, which took place yesterday, is an event of no small importance to all engaged in British industries. Encouraged by the gratifying success of the Exhibition held there in 1888, the citizens of Glasgow have applied themselves to the task of far surpassing their previous efforts, and it cannot be denied that they have scored a triumph. The area occupied by the present buildings, as well as the beautiful grounds in which they are situated—100 acres in all, forming the greater part of the Kelvingrove Park—are far greater in extent than in the former case, but the whole of the space available for exhibits has been taken up, and, indeed, a much more liberal allowance of space would readily have been filled.

The Industrial Hall, which forms the principal building, is 700 ft. in length, and covers six acres; the Machinery Hall occupies an area of 500 ft. by 340 ft.; and joining these is a Grand Avenue 1,000 ft. long and 75 ft. wide. The Fine Art Section is housed in a permanent building of exceptional beauty and magnificence, to which the £50,000 surplus from the Exhibition of 1888 was devoted (together with £200,000 in addition), and which forms a fitting companion to the noble pile which crowns the summit of Gilmorehill beyond the Kelvin.

A striking feature of the present Exhibition is the prominent part played by foreign nations, as well as by our own Colonies. Indeed, it is said that on no previous occasion have foreign manufacturers been so largely represented in this country. Russia (for the first time), France and Japan have large exhibits, the first-named especially having spared no expense in the preparation of a most comprehensive and characteristic display of Russian products.

The Machinery Hall, however, is to us the most interesting and important department. During our preliminary run through the Hall last week, we saw sufficient to convince us that a prolonged visit to the Exhibition cannot fail to amply repay every engineer who can spare the necessary time. As might be supposed, American machine tool manufacturers are well represented; but they are by no means alone, as some very fine exhibits of British machines are in position. One impression left upon us was that our engineering and steel-making industries are far from being in a decadent condition; on the contrary, the excellence of the British exhibits is calculated to inspire one with confident hopes that our predominance in engineering will ere long be reasserted and emphasised.

The fact that practically all machinery in motion is driven by electricity constitutes an advertisement of the first importance for that agent; the electromotor is everywhere in evidence. Herein is seen an advantage, due to the fact that the Corporation of Glasgow is in possession of the supply of electricity to the city, and is not slow to appreciate and to make known the merits of electric power. The municipal telephone system also is available to exhibitors, at the low rate of three guineas per station during the Exhibition.

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We need not dwell upon the amusements which have been provided; they are in abundance, and the best of their kind.

The superhuman efforts of the Tramways Committee, assisted by the energetic manager, Mr. John Young, and the consulting engineer, Mr. H. F. Parshall, with their respective staffs, have been crowned with almost unhoped-for success in the timely completion of the whole of the electric lines which run towards the Exhibition; the formal opening ceremony took place last week, as we stated in our last issue, and actual running for public traffic commenced on Sunday, that day being selected, of course, on account of the comparative stillness of the streets, which only those who have dwelt in Glasgow can truly appreciate.

Praise is due to the compilers of the official catalogue, which was completed in time for the Press view last week, and affords a happy augury of the early completion of the exhibits. It cannot be denied that many of the stalls in the Industrial Hall are in a very backward condition; but those in the Machinery Hall are much more advanced, and we anticipate that in a few weeks they will all be practically finished.

In conclusion, we venture to express the opinion that the newly-opened exhibition cannot fail to stimulate British industries and commerce, and that everyone interested in these matters—as we all should be—ought to spend at least a week on the spot, in studying the lessons to be learnt from the splendid collection of machinery and apparatus brought together by the energy and enterprise of the model city.

Contracts with Consumers.

THE case of the Metropolitan Electric Supply Company, Limited, *v.* Gender, which we conclude in another part of the present issue, involves a number of points of considerable interest to electric supply companies, inasmuch as it deals expressly with the legal relationship of company and consumer, and touches upon the construction and meaning of a certain section in the Electric Lighting Acts, as well as clauses in common use in provisional orders. The action was brought by the plaintiff company to restrain the proprietor of the Red Lion, in Holborn, from taking electric energy from any person other than the plaintiff company. The request for supply, signed by the defendant in November, 1898, contained (*inter alia*) the following clauses:—The consumer agrees to take the whole of the electric energy required for the premises mentioned below from the company for a period of not less than five years; (2) the charge shall be 4½d. per Board of Trade unit. On the margin of the form of request it was noted that in the event of the company's standard rate being reduced below the price therein quoted, the defendant was to have the benefit of the reduction. The defendant gave notice to disconnect in September, 1900, and commenced to take current from the County of London and Brush Provincial Company, who have competing powers of supply in the plaintiffs' district. Upon a threat of legal proceedings, the plaintiffs' service was again connected, but in February, 1901, the defendant gave a second notice to disconnect. A motion for an injunction was then treated as the trial of the action. The defendant raised three defences, with which Mr. Justice Buckley dealt *seriatim*. He contended in the first place that there was no valid contract. On this point his Lordship referred to Sec. 46 of the Mid-London Provisional Order, which gives the consumer a right to be supplied on entering into a written contract, if required, to continue to receive and pay for a supply of energy for a period of at least two years. His Lordship held that inasmuch as the contract permitted by the provisional order "was wider than that by which the defendant was bound," the contract was valid. The form of provisional order in the schedule to the Electric Lighting (Clauses) Act, 1899, provides that undertakers may limit consumers to take supply for *two* years. It was also argued on behalf of the defendant that the contract was void under Secs. 19 and 20 of the Electric Lighting Act, 1882, which provide that every consumer shall be entitled to a supply on the terms on which every other person in the area is entitled under similar circumstances to a corresponding supply. His Lordship held that there was no evidence of undue preference. It was further contended that the contract not to take a supply from elsewhere was negative and void. Upon this point Mr. Justice Buckley said: "In the case of Wolverhampton and Walsall Railway Company *v.* London and North-Western Railway Company, L. R. 6 Eq. 440, Lord Selborne, in deciding whether a certain contract was positive or negative, said: 'I can only say I should think it was the safer and the better rule, if it should be eventually adopted by this Court, to look in all such cases to the substance and not to the form.' I think the contract in this case implied a contract not to take energy from anyone except the plaintiffs, which in a case of this kind, a trade contract for supply, and not a contract for personal service, could be enforced by injunction." The learned judge pointed out that the real defendants to the action were the Brush Provincial Company, whose zealous canvasser had secured an order for his principals from the defendant; and he also pointed out that although upon two or three occasions there had been a stoppage of supply, yet upon the whole the plaintiffs had fulfilled their contract. This agreement resembles one whereby a house-keeper binds herself not to accept any bread except that sold at a particularly low rate by some special fancy baker. We cannot see that, apart from the Electric Lighting Acts, there is any objection to such a contract; but it is clear that time is of the essence of the arrangement. It is not quite clear, however, that a supply company, which is subject to the provisions of the Electric Lighting (Clauses) Acts, 1899, can make any such stipulation. Undertakers are bound to supply, subject to the consumer undertaking to continue to receive and pay for a supply of energy for a period of at least two years of such an amount, that the payment to be made for the supply at the rate of charge for the time being charged by the undertakers for a supply of energy to ordinary consumers within the area of supply, shall not be less than 20 per cent. on the outlay incurred by the undertakers in providing any electric lines required for the particular customer. So long, therefore, as the minimum payment is made, it is difficult to see how the company could restrain the consumer from having wires laid by, and taking a supply from, another company in the district. The case is also of importance as showing that the occurrence of those unfortunate accidents which sometimes cause the supply of electricity to be intermittent, does not constitute sufficient ground for a consumer to give notice determining his contract for supply.

Some Carbide Statistics.—The amount of calcium carbide imported into Germany during the year 1900 was 7,681 metric tons, and the export 224 tons. In the previous year the corresponding figures were 6,374 tons and 636 tons. Estimating the quantity of carbide manufactured within the bounds of the empire at 2,500 tons in both years, the total German consumption for 1899 is seen to have been 8,238 tons, and for 1900 10,180 tons. Of the exports, 86 tons in 1899, and 26 tons in 1900, were sent to Australia. These latter are not very large figures, and they are fortunately decreasing; but they ought to disappear altogether, and the carbide required in the Commonwealth be either made locally or exported from Great Britain.

OVER-SPECIALISATION IN SCIENTIFIC EDUCATION.

After carefully reading the "James Forrest" lecture entitled "Chemistry in its Relations to Engineering," delivered by Prof. F. Clowes before the Institution of Civil Engineers on April 25th, we cannot help feeling that in spite of the author having chosen a very interesting topic, and having given much valuable information, he has scarcely done justice to the importance of his subject.

Speaking as a chemist to an audience of engineers, Dr. Clowes has naturally, perhaps, contented himself with insisting that engineers shall possess a working knowledge of chemistry; but although this proposition is absolutely incontestable, Dr. Clowes does not show how that end may be best achieved, nor does he indicate that it is only one instance of the general law that too narrow or too early specialisation in scientific education is highly undesirable. Instead of maintaining the philosophical tone of the early portion of his address throughout its entire length, Dr. Clowes digresses to give specific examples of the bearing of chemistry upon engineering in a way that unduly concentrates the attention upon some less important aspects of a question with which he had a splendid opportunity of dealing at large. We have among us at the present time three classes of experts—electricians, chemists, and engineers—who are each supposed to be thoroughly acquainted with the theory and practice of his own science; yet so closely are those sciences connected in their various applications, that a man is almost certain to pass an unbalanced judgment upon problems which apparently concern his own subject alone, unless he is well versed in the principles underlying the parallel lines of inquiry. A striking instance of such over-specialisation has been visible for several years past since the art of electro-chemistry has begun to develop. To superintend the new manufacturing processes involved, we have been compelled to create an entirely new type of technician, the electro-chemist, because our chemists were mostly too ignorant of electricity, and our electricians of chemistry, for either to be capable of controlling and managing an electro-chemical factory.

Dr. Clowes has taken the trouble to ascertain from many of our colleges and universities how much time they allow or compel their engineering students to devote to chemistry during the regular course of instruction; and to this list he appends various expressions of opinion from the different professors consulted. Two facts, one in particular, stand out clearly in the replies. The first is, that a three years' course of education is so short that very little time can be devoted to chemistry; the second is, that in many cases the kind of chemical instruction given is not the most suitable for the purpose in view. We observe that several institutions endeavour to teach chemistry by causing the students to perform analysis, ofttimes qualitative. Now, the chemist himself must, of course, have both qualitative and quantitative analysis at his fingers' ends; but with all respect to our professors, analysis is not chemistry; it is a special art elaborated for a special purpose, and qualitative analysis *per se* is bad training for the general man of science. To devise a new analytical process, qualitative or quantitative, requires a sound knowledge of chemical laws; but to repeat that process requires merely manual dexterity, valuable enough in its way, but hardly valuable to the man who desires primarily general knowledge of principles. From another aspect, too, analysis is bad training: the analyst is rightly satisfied if his results are correct; he does not study the expense of his process, the time it takes, and what becomes of his by-products. The proper way to teach chemistry is by synthetical methods, causing the student to prepare substances, telling him the price of his raw materials and finished articles, and showing him that he may not spend pounds in making shillingsworths of things.

But the other point brought to light by Dr. Clowes's investigations is more important to us here, although it is by no means new. Whether he be chemist, electrician, engineer, or, indeed, physician, an accomplished man of science must thoroughly understand the principles underlying two or three of the subjects which most nearly touch his own; and as his training in his special branch can scarcely be completed in three years, three years is not sufficient to convert the college student of average ability into the responsible expert adviser. The duty of the chemical professor (say) is to train his students efficiently in pure chemistry; and as he knows he can hardly do this in three years he naturally grudges every hour given to another science. This is inevitable; the professor would be neglecting his proper functions as well as his interest, were he not to keep the students in his own laboratory every moment of their time. It is very unfortunate that the general parent of to-day has received the notion that his sons can be made into electricians, engineers, or chemists on the three years' system. We cannot stop now to consider whose fault it is that the parent has conceived this notion; but there are many excuses for him. Three years is an appreciable slice out of a youth's lifetime, and his "keep," as well as his fees at college, tax his father's pocket severely. It is not likely that the parent will be willing to prolong that expensive period of training unless he can see some prospect of a return for his outlay. In present conditions a man who is "something in the city" will often make his £1,000 a year after a comparatively short apprenticeship in offices where he has been receiving some salary all the time, being more or less independent of his father from the date he left the primary school. The expert costs his parents £200 or £300 for training alone, and may think himself lucky if he gets a post worth as much as £400 till he reaches middle life.

The fact of the matter is, we want technical education; not the technical education of the politician and the daily newspaper, but real technical education. We want to evolve a race of professors to teach our capitalists and employers of labour that factories cannot be carried on for long at a profit when competition, both at home and abroad, is keen, unless those factories are superintended by highly trained experts; that a laboratory or testing shop may be remunerative even if a balance in its favour cannot be shown on paper; that the technician is constantly making small improvements and effecting petty economies, which amply repay his salary and expenses, and that sooner or later, if he be the proper kind of man, he will undoubtedly produce some invention which even his employer must admit to be visibly valuable. On somewhat analogous lines we want the technical education of the British parent, that he shall realise the importance of science, and shall be willing to find the money to enable his sons to receive a sound scientific education; but we feel diffidence in writing upon this matter, for the reason we have already indicated. We are free to confess that by pursuing these reflections we lay ourselves open to a charge —on the part of hasty critics, at all events—of arguing in a circle. Many of our students are not trained comprehensively enough to deserve high salaries at the outset of their careers; our employers realise the fact by intuition or experience. Employers, therefore, will not pay high salaries; parents, therefore, put their brightest sons to commerce, where less capital is needed, or where it is invested in more material objects than a mere brain. Students have not the patience to undergo a lengthy training when their earnings will be smaller than those of their brothers in the City; therefore the students are not trained so as to deserve high salaries. But it is quite easy to leave this vicious circle, and to strike out at a distinct tangent. If our employers can only be persuaded that a proper expert is worth more money than a head clerk, parents will soon be willing to support their sons while the necessary education is being received; if our employers will pay salaries commensurate with those taken by commercialists of similar ability and experience, students will be willing to devote four or five years to obtaining that ability and experience. And if students will devote four or five years to special training, our professors are perfectly competent to train them properly. That is the technical education the British nation requires, not the sort of thing which makes the mechanic too conceited to obey orders.

For the sake of simplicity and brevity we have referred only to the primary subjects of scientific education. Other matters must not be neglected: mathematics, history, and political economy. Each of these is important; but their value is apt to be either under or over estimated, and to appreciate them exactly may form the text of some future article.

LEGAL.

METROPOLITAN ELECTRIC SUPPLY COMPANY, LIMITED *v.* GENDER.

(*Continued from page* 700.)

On the hearing of this case being resumed, the cross-examination of Mr. Todd was continued by Mr. Eady. In reply to a number of questions, WITNESS said that within the area of the company there were five stations; Willesden was outside the area of supply, but it was a generating station. In the year 1899 the stations which had to be worked at high pressure in order to obtain all the current possible were Amberley Street, Manchester Square, and Rathbone Place.

The reasons you gave when you were unable to fulfil your statutory obligations were that you had not sufficient current, and that you were doing all you possibly could at Willesden where you had great trouble with your generating engines?—Yes.

In 1899, when you had to buy from other concerns a very large amount of current, and in 1900 when you had to buy some current, were you using all your available current?—We had always spare current at Holborn. We had spare current at Sardinia Street station, but we were limited by the size of our mains as to the amount of the current we transmitted.

Did you transmit elsewhere all the current that your mains could carry?—As near as possible.

Is it a fact that within the last two years you have received complaints from persons in the Holborn district as to the electric supply?—We have receive complaints, but I don't know of any case where the fault was due to our supply.

Have customers left you, assigning as their reason insufficient supply?—I am unable to answer that. I cannot say that we have had frequent complaints within the last two years as to deficient supply.

The Inns of Court Hotel was one of your customers. Did you have complaints from that hotel?—We may have had.

Did you have complaints from Glaves, Oxford Street, and has that supply been stopped?—I cannot say.

Mr. ASTBURY: I am told Mr. Glaves still takes his light from us.

Further cross-examined, WITNESS admitted that there might have been complaints from persons in Lincoln's Inn Fields. On January 5th, 1898, there was an extinction at 3.20 p.m., and the main was disconnected on account of an earth fault. On November 17th, 1900, the pressure fell about 10 per cent. and on January 8th last the pressure also was low. The light would not have been so strong on these dates.

Re-examined by Mr. ASTBURY, WITNESS said the company paid a dividend of 6 per cent. last year.

Take a 16-C.P. lamp made for 100-volt current; what pressure would that lamp stand without bursting?—For a short time it might stand 120 volts.

Is it possible to do injury to it at less than 110 volts?—The effect of 110 volts, if maintained, might blacken the lamp.

What is the least voltage that would destroy a 100-volt lamp in a few minutes?—130 to 140 volts.

Are you quite sure that a voltage under 110 could not injure a lamp if it only lasted a few moments?—Yes.

And are you sure, from the reading of your log, that the pressure in Gender's premises between six and seven o'clock on the night he speaks of broken lamps could not have exceeded 103 volts?—It was impossible that it could.

In reply to further questions, WITNESS said that when complaints of low potential were received from customers, a recording instrument was fixed on the meter. He had no instance of any case where the voltage was less than 100½. Every possible precaution was taken to prevent accidents, but these sometimes occurred in the best regulated companies. Any failure of supply from the Rathbone Street station could not effect Gender's current. The Metropolitan Electric Light Company might have bought a little current from the City Company in 1900, but it had never purchased any current to assist the direct supply since November, 1899.

Mr. JOHN PAGE, superintendent of the canvassing and contract department of the plaintiff company, examined by Mr. SARGEANT, said one of the canvassers was named Wright. The agreement Gender signed was left with him to be read at his leisure, and returned by post. He remembered it being reported that Gender's supply was disconnected in September or the beginning of October, 1900. About that time he called on defendant, and informed him that the company would hold him liable for breach of contract. At a later stage defendant made an appointment with him. He then said he was quite satisfied with the light, and wished to have no unpleasantness with the company.

Did he give any reason for wishing to be disconnected?—When he saw me in my office he said the canvasser of the County of London and Provincial Brush Company had been such a nuisance that he had been obliged to go to that company in self-defence.

Did he suggest that there was anything wrong with your supply to him?—Nothing whatever.

Did he say anything about the terms upon which the County of London Company were to give the supply?—No, but he stated that their canvasser had told him that the County of London Company would see him through any action we might bring against him.

Is it the duty of Mr. Wright to report to you any complaints he receives from customers?—Yes.

Has he ever reported any complaints made by defendant?—Never. In the event of him reporting a complaint to me, I should ask him to write out a memorandum which I should sign and forward to Mr. Todd. I have never written any such memorandum.

Replying to further questions, WITNESS said he had seen defendant from time to time, but not on matters of business. He had been on the most friendly terms with defendant and had visited his house. After pointing out his breach of contract, defendant asked to be connected again. He did not have the letter containing that request, but it was in possession of the company. He recollected that the general manager waived the claim for making the connection again.

Do you recollect getting another letter from defendant about February last complaining of the supply?—Any letter of the kind would come direct to me in the course of the company's business. If it was a complaint in the competitive area it would have been handed in to me to investigate and then sent to the engineer's office. I attend at the office every morning, and I have never received any such letter from the defendant.

Have you received complaints from other customers as to defective supply?—No. We have been practically free from such complaints at the Sardinia Street station. The supply has been most satisfactory.

Cross-examined by Mr. PAGE: You mean by the competitive area the district in which the other company supplies customers?—Yes.

Don't you investigate other complaints?—Oh, yes.

I would like his Lordship just to see the happy effects of competition. Am I right in saying that in the Strand and Holborn districts there are competing companies?—Yes.

Unfortunately, in Paddington and Marylebone districts there are no competing companies as yet. Who investigates the complaints there?—One of my assistants, as a rule.

You personally do not?—Oh, yes I do. In an important case I go myself.

Have you any note or memorandum of what the defendant said concerning the Brush Company's canvasser?—I made no note of the conversation, but I remember it.

Did he mention the name of the canvasser?—I don't think he did, but I know the canvasser.

Is there any written acceptance by the company of defendants' contract?—No.

Is it the practice of the company not to sign any part of the printed agreement themselves?—Not unless we are asked to. There are some signed by the company. If anybody wishes it the secretary would give his signature directly.

Your printed form has been altered. That which Gender signed said "the consumer will take the whole of the electrical energy for a period of not less than five years." Since then there has been added the words "and shall take from no other company or person?—Yes.

It makes a negative stipulation. When were these new forms introduced?—When the others were out of print. The new forms were printed subject to the approval of our solicitor. I don't know the circumstances under which the words were added.

Gender's stipulation was for five years, and the price was to be 4½d. per unit. What was the ordinary price for current at the date of his contract of November 16th, 1899?—For private houses it would be 6d. per unit, and for trade purposes it would be 6d. and 5d. To get the 5d. rate a customer would have to consume 5 units per 8-C.P. lamp per quarter.

Upon what terms was it reduced to 4½d. per unit?—It was reduced subject to a consumer entering into a contract for a term of years. That was the only element that made the difference.

Was in every case the term of years the same?—No.

Did you try to get as long a term as you could?—Not necessarily. It depended altogether with whom we were dealing. The terms varied from five years to two years. I am under the impression that there was nothing less than two years.

What governed the length of the term of contract?—My discretion chiefly.

Would you have a man for two years if you thought he was not going to pay?—If such a man came to me and said that in order to get the 4½d. rate he would sign a two years' contract, I could not well refuse him, but I would first do all I could do to keep him off.

Further cross-examined, WITNESS said the contract dated June 6th, 1899, for the Old Thatched House in Red Lion Street was for three years, and that the tenant of the Rugby Tavern, Great James Street, signed a contract for two years from March 8th, 1900, the rate to be 4½d. per unit. Mr. Gates, Oxford Street, who had been previously examined, signed a contract on May 16th, 1895, for a supply at 7½d. a unit. Later he signed one for a supply at 4½d. per unit, and on October 8th, 1900, he had a fresh contract for two years, the rate to be 4d. per unit.

Why was Gates given a contract at 4d. per unit?—Because he is a large consumer, and uses the light in day hours.

By his contract he does not undertake to use any particular amount of electrical energy?—No; but we know what he does use, and he is one of our oldest customers.

Answering further questions, WITNESS said it was about 1897 that contracts were first entered into for a term of years. In 1898 three years and two years' contracts was quite common. Instructions had been issued against two-year contracts, but the instructions respecting contracts were different now.

Are there many of your customers who are paying 4d. per unit?—I should say in the Holborn district about 50 customers are taking the current at 4d.

Are there any cases where you charge more than 4½d. when the light is used for trade purposes?—Yes.

Are there houses where you charge only 4½d. though no contract has been entered into?—I think there are two or three. Certainly not more than half a dozen, and they are particular persons we know.

Why do you charge them 4½d. without a contract for a term of years, and say to others that they must have a contract if they want

the light at 4½d.?—They are old customers in whom I have perfect confidence.

Do you mean to say that there are only five or six people whom you think would pay their bills if you let them have the current at 4½d. without entering into a contract?—We deal with every case individually. We may have other good reasons for letting customers have the light at 4½d. without signing a contract.

Do you charge the Inns of Court Hotel 4d.?—Yes.

Have they a contract for a term of years?—They signed a contract for a year from last December.

Re-examined by Mr. Astbury, K.C., Witness said the account rendered to the tenant of the Old Thatched House was considerably larger than that of the defendant's. Sometimes a person who had a large number of lights in his premises was not so good as one who had a small number of lamps, but used them well. During the year 1900 the Old Thatched House paid £108 12s. 11d. for electrical energy, as against £54 paid by the defendant. With regard to Mr. Gates, it was a great advantage to get customers who made use of the electric light during the day.

Henry Heath, who was next called, said, in answer to Mr. Astbury, that he had a cigar shop at 240, Holborn, and a hosier's shop at 302, Holborn. Both premises were lit by current supplied by the plaintiff company. He had taken the supply for seven or eight years and had no complaint to make. The light did fail on one occasion, but that he understood was due to an accident at the electric works.

At the close of the plaintiffs' case, Mr. Swinfen Eady, on behalf of the defendant, submitted that there was no contract between the plaintiffs and the defendant that the latter would not take electrical energy from anybody else but the plaintiff company.

His Lordship: You must address me on that. At present I think there is.

Mr. Eady: I submit there is not, in express terms. It is not so expressed in language. Of course, in one sense a contract to do a particular thing involves the negative not to do anything inconsistent with it.

His Lordship: What do you understand the meaning of the word "whole" is?

Mr. Eady: I understand it to mean the whole or all. The consumer agrees to take the whole of the electric energy—

His Lordship: If he takes part from somebody else, could he not be restrained?

Mr. Eady: Not by injunction, I submit. It is not a breach which will be restrained by injunction. That is a point which will have to be considered. I say, in the first place, that there can be no injunction, and, in the second place, that the plaintiffs have proved no damage. I say, so far as the contract is concerned, it now appears that the plaintiff company supplied other persons on better terms than they did the defendant. I say we are entitled to be supplied on the same terms as anybody else, because, under their statute, they cannot give any undue preference.

His Lordship: Suppose that the facts are so; you say that, by the contract, you ought to pay less, or that the contract is bad altogether?

Mr. Eady: The first question is whether the contract, when it was entered into, was good or bad. The plaintiffs cannot enter into any contract which would give any undue preference.

His Lordship: You say that if anybody paid 4d., you ought not to pay anything higher, and that your contract was bad altogether.

Mr. Eady: Yes. I say further that if the contract was good when it was entered into, better terms were made by the plaintiffs with other persons, and that the defendant is entitled to the benefit of those better terms.

His Lordship: You say further that if the contract is good, you are entitled to pay less?

Mr. Eady: Yes. We also say that the contract is bad, on the ground that there was no consideration whatever for the contract for a term of years. Under the statute the plaintiffs are bound to supply current to anybody who applies for it on the current terms. If they were supplying it to other people for 4½d., there was no contract on our part to take it for five years. There was no consideration of our taking it for five years. Then there is a further question that by reason of the defects in the light, the contract cannot be enforced against us.

His Lordship: I want to understand that point. Let us assume that the contract is a good contract, and that the light supplied is bad. On what ground do you say that the contract is at an end?

Mr. Eady: On the ground that the plaintiffs could not get specific performance of it. I also say and put it as high as this that it is a reason or excuse for our getting the current elsewhere.

His Lordship: As a legal proposition, excuse will not do. You are either bound or not by the contract.

Mr. Eady said it would be probably the most convenient course for him to call his evidence first, and to address his Lordship on the law afterwards, and accordingly his Lordship assenting to this course being followed,

The Defendant, examined by Mr. Eady, said he took possession of the Red Lion, in Holborn, on November 1st, 1898. When he took possession the house was already installed with the electric light, and the current was being taken from the plaintiff company. He continued to take the current in the same way. A representative of the plaintiff company called and saw him several times, but not officially. The first suggestion as to a contract was made soon after he got to the Red Lion. Witness was ill at the time a paper was left for him to sign, and he signed it. He did not think that the words "five years" were mentioned to him in any way or shape. If they had been, he did not think he would have signed the contract. He never liked the electric light there, and people coming up the road had often said that there was not sufficient light to show that it was a public-house. Sometimes the light was fair, and sometimes very bad. The light was seldom sufficiently good to enable a person to read a newspaper in the bar. It was a matter of frequent complaint in the business. Other witnesses would speak as to this—voluntary witnesses, not paid ones. He had complained to Mr. Wright about the light. They had an installation of gas in the bar. He had no reason in asking the plaintiffs to disconnect except the poor quality of the light supplied. During the time that they took the plaintiffs' current they used generally to light 27 lamps. Now they only used 13 of the 27 lamps. They had now sufficient light with the 13 lamps. There had been no alteration in the lamps or fittings. If he was restrained by injunction from taking current from anybody else but the plaintiffs, he would not attempt to use electric light in the public house at all. He would put on gas at once to save expense. He certainly should not return to the plaintiff company, having regard to his past experience of them. One of the most important things in a public house is to have a good light.

At the close of the witness' examination-in-chief, the further hearing was adjourned till Monday.

When the hearing of the case was resumed on Monday last week,

Mr. Gender was cross-examined by Mr. Astbury. He said he had nine lamps immediately over the counter, and frequently the light was so bad that customers could not tell whether they were being supplied with ale or stout. He bought the electric lamps from different places. One lot came from the John Bull Lamp Company, Covent Garden. He had also burned Edison lamps of 16 c.p. On one occasion the filaments of four lamps were burst by a sudden flare of light; 22 were burning on the premises at the time; they continued to burn all right. He had no recollection of signing the application for light, or of reading the paper through. It was not his desire to suggest that the company inserted the words "for five years" in the contract after he had given his signature.

Are you going to pay the costs of this action if you lose?—I shall have to pay the greater part of it. The County Company will not assist me much.

Is Mr. Morse, who is acting in this case, the County and Brush Company's solicitor?—I believe so. I was advised to go to him because he knew about electric light.

Not because he was acting for the company?—I did not know that he was their solicitor entirely.

You have not exactly got an agreement from the company that they shall pay for the defence of this action, but you have got some understanding from them?—I have been told that they will assist me.

From whom did you get the undertaking?—From Mr. Rennie, the secretary.

To what extent has the company agreed to assist you?—I don't know.

Have they agreed to pay all the costs?—No, they have not.

Have you agreed to pay any?—I have not. Replying to further questions, witness admitted having a letter from the company to say that they would assist him in the action. That letter was in the possession of his wife's solicitor. The letter was written from the office of Mr. Morse, the company's solicitor, but he could not say when it was written.

Mr. Astbury asked for the production of the letter written by Mr. Morse to defendant, and for a copy of the answer from defendant to Mr. Morse. Mr. Eady said they were not in Court.

Further cross-examined, Witness said it was not a fact that he was not willing to defend the action unless the County and Brush Company paid the costs.

Is it a fact that as soon as you got an undertaking from the County Company's solicitor, you left it to Mr. Morse to defend this action as he thought best?—That is so.

It would rather surprise you if you were to receive a bill of costs for this case?—I don't want one certainly.

The County Company's solicitor has never suggested any bill?—I did not have much time to speak about it.

Do you suggest that the 13 lights you are now using in the bar give more light than the old 27 lights did?—Yes. They are better than the 27, when the light was bad. When the supply of the Metropolitan Company was good it was all right.

Can you give me any other date when you saw the light go out or flare up?—I never kept a note of dates.

Replying to further questions, Witness admitted that the County Company's canvasser had told him that that company would see him through in the event of an action, but that gentleman had no authority for making such a statement. Mr. Rennie, of the County Company, had told him that he did not think his agreement with the Metropolitan Company was binding. That was in February, and Mr. Rennie further told him if there was any trouble in the matter he would be assisted.

Mr. Erbach, licensed victualler, Southwark Street, the next witness called, said he was a frequent visitor at the defendant's premises. On February 1st when there he saw the light suddenly go out. It then came on strongly and broke some of the lamps. He saw Mr. Gender fix up new lamps.

Mr. James Mills, examined, said that from January 11th to May, 1900, he was manager of the defendant's public house in Holborn. It was a standing joke on the part of the customers to ask where the light was.

Cross-examined, he could not say that the light was so bad that it was impossible to read a newspaper in the bar by it. He was an old-fashioned man, and preferred gas to the electric light.

Re-examined:—When the whole of the 27 lights were used the light was very unsatisfactory.

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Mr. H. Thomas Culliford, a photographer, carrying on business in Fulwood Rents, Holborn, examined by Mr. Steward Smith, said that his place was lighted by electricity, and the energy was formerly supplied by the Metropolitan Electric Supply Company. It was very bad indeed. About 30 of the 50 lamps were generally used. They changed from the Metropolitan Electric Supply Company to the County Company in October, 1900. The light was four times as good by the County Company as by the Metropolitan Electric Supply Company,

Cross-examined by Mr. Astbury: In June, 1900, the Metropolitan Electric Supply Company disconnected their supply because their account was not paid. A cheque was, however, sent the next morning. Since he had been cut off by the plaintiff company, he had not been an active party in trying to get people to leave the Metropolitan Electric Supply Company, and go to the County Company. He, however, told Mr. Gender that he would find it beneficial if he made the change. It was most important that they should have a good light in their particular business.

Re-examined: There was no foundation for the suggestion that his firm could not pay the charges of the Metropolitan Electric Supply Company. That company had never applied for payment of their account.

Mr. W. H. Hinchcoe, examined by Mr. Eady, said he was a partner in a firm of tailors carrying on business in High Holborn. He went to Gender's house more or less every day. He had been there occasionally in the evening. He had observed the light there when it was supplied by the Metropolitan Company. The light was indifferent when it was supplied by the Metropolitan Company. His firm were customers of the plaintiff company by contract. The light was very indifferent, and had been so always. They had had it for about seven years. It was constant and regular, except for occasional breakdowns, but it was always generally bad.

Cross-examined: He could not say whether his firm had ever made any complaint to any responsible person connected with the plaintiff company as to the indifferent quality of the light supplied.

Mr. J. T. Trenchard, a tailor carrying on business at 77, Red Lion Street, examined by Mr. Stewart Smith, said his shop was lighted by electricity supplied by the plaintiff company, supplied since 1898. They had four 16-c.p. lamps in the window, and two 32-c.p. lamps at the back of the shop. The light was not satisfactory at all. During the last two years the lamps had gone out completely four times to his own knowledge. He knew Mr. Gender's house. He was there once or twice a day. He had been there when the electric light was burning in the bar. It seems very similar to his own until about a couple of months ago.

Cross-examined: The light in his premises was generally constant and regular, but he considered it ought to be more brilliant.

This evidence closing the defendant's case, counsel addressed his Lordship on the whole case on behalf of their respective clients. The hearing was again adjourned.

On Tuesday last week, after hearing Mr. Astbury, K.C., on behalf of the plaintiff company,

Mr. Justice Buckley gave judgment. He said the contract entered into by defendant and the plaintiff company on November 16th, 1898, had as its first article the following:—"The consumer agrees to take the whole of the electric energy required for the premises mentioned below from the company for a period of not less than five years." On September 3rd, 1900, the defendant wrote asking that the service be disconnected. When defendant saw Page, the plaintiffs' employée, Gender said he had been pressed by the canvasser of the County of London Company to leave plaintiff company, and the canvasser was such a nuisance that he had to do something. Defendant did not then say anything to Page by way of complaint as to the light supplied by plaintiffs after the letter from the plaintiffs' solicitors, and in the interview with Page, defendant asked to be reconnected with the Metropolitan Electric Light Company, and matters went on all right till February, 1901. At that time Gender wrote to the plaintiffs' secretary, "As I am dissatisfied with your light, I have instructed another company to fix up their light, and I am now using same. I shall be obliged if you will come and take your meter away, and let me have your account up to date, as I shall object to pay rent after to-day." Defendant had finally abandoned the plaintiff company, and was taking his supply from the County Company. On March 16th, 1901, a writ was issued in the action, and an order was afterwards asked for an injunction to restrain defendant from taking his supply from any company other than the plaintiffs. Defendant had filed an affidavit in which he said, "On Friday, February 1st last, I was in my public-house at 6.20 in the evening, when the electric light suddenly went out, and we had to light the gas. After a few minutes the electric light flared up, and destroyed four lamps in the bar in which I was. I believe some lamps were also destroyed upstairs. The following evening I wrote the plaintiff company a letter of which I did not keep a copy, and asked them to send a man to see if the fault was in their mains or in my fittings. Obtaining no reply I gave orders to the County of London Company to supply my premises with electric light." In another paragraph defendant represented that he had made frequent complaints to Mr. Wright, and another representative of the plaintiff company. Defendant had been asked to give particulars of the occasions upon which he alleged the light had been deficient, and he gave particulars in general terms except February 1st, 1901. Proceeding, his Lordship said he was perfectly satisfied that at 6.20 p.m. on February 1st, 1901, that there was not in the plaintiffs' works any such breakdown or sudden alteration of voltage as to account for the incident which was said to have taken place at the defendant's premises. Plaintiffs' engineer had been called, and a sheet had been produced which recorded the voltage at the Sardinia Street premises between six and seven on the evening of February 1st. The voltage for the time in question was a continuous voltage of 102, and it had been proved in Court that the result of that would be just about the best possible for a good light, and which would be about 101 or 102. With that evidence he was entirely satisfied. As to the evidence defendant had given as to what took place in his bar, his Lordship was not satisfied that that had not been greatly exaggerated. It seemed to him there were two possible explanations. Either the incident never took place, or if it did take place, it was due not to the fault of the plaintiff company, but to defendant's installation fittings. It was said that defendant had 27 lights in the bar, that suddenly the lights became dull and then flared up, destroying four of the lamps. There were various ways to account for that, and he had from defendant's own witnesses that the installation obviously was defective on the premises in some particulars. The manager, Mr. Mills, had given an instance of this. Altogether the evidence defendant had tendered concerning the supply of light was conflicting, and in many cases grossly exaggerated. One witness had said the light was so bad that customers could not see to read a newspaper. Mr. Mills, the manager of the defendant, had never known an occasion when the light was so bad that they could not read newspapers at the bar. Mr. Hinchcoe, tailor, had said he was a customer of plaintiffs for many years. He had never made any complaint at all concerning the light, and in January, 1898, he signed a fresh contract for five years. Then there was Mr. Culliford. He had strong partisan views. The company represented that they had had to make repeated applications to him for his account. Ultimately they cut off his supply, and the next morning he sent them a cheque for their bill. It was a fact that he had made payment to the company under considerable pressure. As against his evidence, there was the evidence of people like the manager of the Holborn Music Hall, the manager of the restaurant adjoining the music hall, Mr. Gates, who had a large café in Holborn, and Mr. Kuss, who also had premises in Holborn. These witnesses said they had no serious cause of complaint with regard to the light supplied by the company. Subject to the accidents which the company admitted, the light had been good. It was also necessary to bear in mind that defendant never made any complaint to Page or Wright as to the quality of the light. Therefore, on the question as to whether the light supplied by plaintiffs was reasonably such as parties contracting were entitled to receive, he found the facts in favour of plaintiffs. It was further proved that the defendant, Gender, was not really the person defending the action at all. He was solicited by the County Company to break his contract with the plaintiffs, and he did so, and his solicitor, obtained from Mr. Sydney Morse, the solicitor for the County Company, a letter, the exact terms of which had not been disclosed, but the substance of it was that the County Company would assist him in the action. The action, therefore, was really one between the two lighting companies, and not one between the plaintiff company and Gender. One of the defences raised was that the contract entered into was affirmative and not negative. The Court was asked to grant an injunction upon the footing that there was a negative binding. In the case before him the consumer agreed to take the whole of the electric energy required for his premises from the plaintiffs. The company was bound to supply that energy under Act of Parliament. The only question was as to price, and that was fixed at 4½d. per unit. There was no affirmative contract in this case. Gender said he would take the whole of the electric energy. He could burn gas if he liked, but if he used electric energy he must take it from no other company. It was argued that the contract was invalid in so far as it gave graduated rates, and that it bound parties for a term of years. He thought that point was entirely answered by the language of the order. The London Order, Section 46, provided that where an occupier of premises required a supply of energy, he should enter into a written contract with the undertakers to receive and pay for the supply of energy for a period of at least two years. Section 52 further set forth that the undertakers might make any agreement with the consumer as to the price to be charged. There was thus an express statutory authority to obtain a contract from the consumer that he would continue to receive the supply for at least two years. Sections 19 and 20 of the Electric Lighting Act, 1882, provided that undue preference must not be given to any particular consumer. It was said that there were contracts with other consumers which were different in their terms. The instances given were three. The occupier of the Rugby Tavern entered into a contract in March, 1898, for five years at 4½d. per unit; another occupier of the same tavern had a contract for two years at 4½d. per unit, and on February 14th, 1901, there was a third contract entered into for two years at 4½d. In the case of the Old Thatched House there was a contract of June 6th, 1898, for three years at 4½d. per unit. Mr. Gates in 1895 paid 7½d., but no term of years was fixed. On October 6th, 1899, he entered into a contract for one year, the rate to be 4½d., and on October 8th, 1900, he entered into a third contract for two years, the rate to be 4d. Section 19 said "Every person within such area is entitled to a supply on the same terms at which any other person in the area is entitled under similar circumstances to a corresponding supply." That last expression, "under similar circumstances," gave a latitude to the company to make bargains with customers where the circumstances differed and the supply did not correspond. Gates was a very different customer from Gender. He was a large consumer, and he was a consumer who dealt largely on the day current as distinguished from the night current. It was to the advantage of the company to get customers to take a day supply, because then they obtained some return for running their plant during the daytime, which otherwise would prove unproductive. The twentieth section of the Order gave direct statutory authority to make the charge within 8d. per unit. He

thought the facts of the case showed that there had been no undue preference. Mr. Page, the company's canvasser, had told them that he took the circumstances of each case under consideration when fixing the price. He found that the contract had been established. Therefore he would grant the injunction to restrain the defendant during the remainder of the five years' contract entered into in 1898 from taking the electric energy required for his premises from any other person or company other than the plaintiffs. He, however, reserved liberty to defendant to discontinue taking the supply, if it were not efficient, or such as plaintiffs were bound to give under Act of Parliament. The plaintiffs would be awarded costs.

Mr. EADY asked his Lordship if he would suspend the injunction for 14 days if the defendant appealed.

His Lordship agreed.

River Plate Construction Company, Limited.

On the 25th ult., in the Chancery Division, Mr. Justice Farwell had before him the matter of an arbitration between the River Plate Construction Company, James Capel & Co., of 31, Throgmorton Street, and Charles Bright, of 14, Copthall Avenue. It was a motion by Mr. Bright to set aside an award of March 11th on the ground that it was void by reason of its uncertainty, and that the arbitrator had not properly heard and determined the matters in dispute according to the provisions of the agreement between the parties of August 10th, 1899. Mr. Cooper Willis, K.C., and Mr. F. M. P. Schiller (instructed by Messrs. Petch & Smuethcoute) appeared for Mr. Bright; while Mr. Upjohn, K.C., Mr. E. Hume Williams, K.C., and Mr. MacSwinney (instructed by Messrs. Norton, Rose, Norton & Co.) represented the company and the other respondents.

Mr. COOPER WILLIS said the agreement forming the subject of the award was between the Construction Company of the first part; Messrs. Capel, the brokers, of the second part, and Mr. Bright, the vendor, of the third part. It recited among other things that it was proposed to form an English company for the purpose of purchasing from La Sociedad Commercial de Monte Video, three tramway undertakings exclusive of the hotel, and other property not directly connected with the tramways, and that negotiations were proceeding, or were about to be commenced, by the vendor with the municipality for the purposes of modifying the terms of the concessions, so that they should all be made for a period of 75 years, and also that the tramways might be worked by electricity instead of by animal traction; and further, that the vendor was prepared to enter into a sub-contract with the Construction Company to complete the said tramways so as to be fit for electrical traction.

Mr. Upjohn objected that the motion was irregular, and that the plaintiff could not move to set aside the award, because he had adopted it by acting upon it. Mr. Cooper Willis asked leave to amend, but his Lordship said he should be abrogating the rules if he allowed such amendment. Mr. Upjohn pointed out that Mr. Bright, by his acts, affirmed the award. Transfers had been executed; and the purchaser for Mr. Bright refused to pay the purchase money on some ground that the shares did not answer the description under which they were sold.

His LORDSHIP, in giving judgment, said it was a motion to set aside an award by Mr. Chadwyck-Healey, and the preliminary objection was taken that the applicant had adopted the award by acting upon it. The award arose out of an agreement in which there was this provision:—

> If at the expiration of six months from the date hereof, and, in all respects time and the fulfilment of all matters to be done by this date shall be of the essence of the contract, the vendor shall not have procured from the municipality a modification of the said three concessions, so that the same shall be for 75 years, or such other terms as the Construction Company shall approve, and have obtained the leave of the municipality that the said tramways shall be worked by electricity, or shall have failed in obtaining either of the said matters, then the Construction Company shall remain the owner of the shares in La Sociedad Commercial de Monte Video and of all property owned by the said company, and the vendor will forthwith pay to the brokers the sum of £60,000 as purchase money for half the ordinary shares to the nominal value of £120,000 in the said Construction Company to be subscribed by the brokers or their friends, as hereinbefore provided, and the brokers will transfer, or procure the transfer of, such ordinary shares to the nominal value of £60,000, fully paid, to the vendor.

Mr. Bright commenced an action on February 9th, 1900, and sought a declaration that the defendants, Capel & Co., were not entitled to call on the plaintiff to purchase 60,000 ordinary shares. The matter eventually went to Mr. Chadwyck-Healey, who directed "That the said Charles Bright do forthwith pay to the said James Capel & Co. the sum of £60,000 as purchase money for shares to the like nominal amount in the River Plate Construction Company, Limited, being half the ordinary shares to the nominal value of £120,000 in the same company, and that the said James Capel and Co. do, upon payment of the said sum, duly transfer, or procure the transfer, to the said Charles Bright of such ordinary shares to the nominal value of £60,000 as fully paid, and that such transfer be forthwith duly registered by the said River Plate Construction Company, Limited." Following on this, an order was made in chambers making the award a rule of Court. On March 28th the solicitors for the company wrote to Mr. Bright, calling upon him to comply with the Order of Court, and informing him that the transfers of the shares had been executed and lodged with the secretary with the certificates for the sale, and that he would attend at Messrs. Capel's at four o'clock on Friday and on Monday, when Mr. Bright would have the opportunity of taking the transfers on payment of the £60,000. The letter added that if Mr. Bright did not attend, he would be treated as in default. Mr. Bright replied that, without prejudice to the illegality of the award, which he was taking steps to set aside, he had decided to purchase the shares under the agreement; and as he had sold the same, he would proceed to take the transfers. A meeting followed on Friday, the 29th. The secretary had with him the transfers of the 60,000 shares, and produced them with the certificates; but as Mr. Bright did not produce the £60,000, the documents were not handed to him. On March 30th, Mr. Bright gave notice of motion to set aside the award. In his Lordship's opinion, Mr. Bright, before giving his notice of motion to set aside the award, had adopted it by acting upon it. It was to be observed that Mr. Bright had no right to the 60,000 shares mentioned in the original agreement. The only 60,000 shares which arose in the matter were the 60,000 under the award, and when he said he had sold 60,000 shares he could only mean—and his Lordship held that he meant—the shares coming under the agreement, and construed by the arbitrator in the award. He had got the case of a man who sought to set aside an award after he had acted upon it, because a plaintiff who had accepted the costs of the award was precluded from setting it aside. He had no right to the shares except under the award, and the arbitrator held he was bound to take them. He could not have compelled the transfer of the shares except under the award. He had done an unequivocal act to the knowledge of other persons which he could not retract; the preliminary objection must, therefore, be allowed, and the motion be dismissed with costs.

Mr. UPJOHN, K.C., applied, for the purpose of enforcing the award, that his Lordship's order should be for a sale of the shares.

His LORDSHIP: Does Mr. Bright no longer desire to take the shares?

Mr. COOPER WILLIS said that was so.

Mr. UPJOHN: My application is that there should be an order for sale by auction without reserve of the 60,000 shares in the Construction Company, he having leave to bid, and that the proceeds of sale should be applied in payment of the purchase money.

His LORDSHIP said the application was premature, and ultimately, on Mr. Cooper Willis wishing to appeal, Mr. Upjohn undertook not to issue execution or take any step under the judgment providing he prosecuted the appeal within a week.

London County Council v. the Metropolitan Electric Supply Company.

In the Chancery Division of the High Courts of Justice on Wednesday last week, before Mr. Justice Farwell, an action was heard as between the London County Council and the Metropolitan Electrical Supply Company, Limited. The point raised was as to the interpretation of a clause in the Council's Act defining the conditions under which the Council takes over for the purposes of the Holborn to Strand improvement scheme the Sardinia Street works of the company, and whether the plant to be supplied on re-instalment of the plant hitherto possessed by the Electric Supply Company should be plant not only capable of generating and supplying 4,000 KW., but should include additional plant to enable the company to furnish that supply, even if the plant which ordinarily could produce that output of electrical energy were temporarily put out of work for repairs, or stopped by accidents. Mr. Haldane, K.C., Mr. Jenkins, K.C., and Mr. Methold represented the County Council, and the counsel for the Metropolitan Electric Supply Company were Mr. Cripps, K.C., Mr. Balfour Browne, K.C., Mr. Butcher, K.C., and Mr. Sarjeant.

Mr. HALDANE, in opening the case, said that the question was one simply of construction, and his Lordship would have decided it simply on the motion, had he not felt—as they all felt—that certain facts should be before the Court before the question of construction was decided. The London County Council was making a great improvement in the form of a new street, extending from the Strand to High Holborn, and in the construction of that new street they had to take a piece of ground which formed the site of a station of the defendant company. When the Bill was before the Parliamentary Committee, a clause was negotiated which now required interpretation. The defendant company had their establishments on a site in Sardinia Street, which was going to be taken by the County Council for their improvements. The machinery, plant, and works at the time the Act was passed were capable of generating 3,600 KW., and no more. By the 55th section of the Act it was provided that the Council should not enter upon or use any part of the company's present site until they had provided, at their own expense, a site and buildings for a new generating station. The clause was a re-instating clause. The County Council were simply to give the company what the company had had before. The whole scheme of the section in the Act was re-instalment and nothing new. The company were to make the station themselves, and the obligation of the London County Council was to pay in terms defined by a later clause. What the company had to do was to erect a station—not plant—for transforming, transmitting and conveying electrical energy. His Lordship would observe the word "transforming." The company had great works at Willesden, and it either did now, or was going to do, send currents at a very high potential into London and there transform them into low pressures suitable for local uses. Therefore, it was put in that it was to be a transforming station, and he thought that it would be found that the company did the whole of its work by transformers instead of generating the energy at their different stations. The Council was to pay a sum equal to the cost and expenses of erecting and fitting up a new generating station upon a new site with new plant. The parties were fighting as to the plant and as to capacity and supply of electrical energy to the amount of 4,000 KW., and the County Council were to pay the company the costs of any loss sustained in consequence of the change. The defence had taken a ground new from that which was taken on the motion. The plaintiffs agreed that

there must be a plant capable of sending out continuously 4,000 KW.; and certainly any plant constructed by a skilled engineer would generate a little more than the actual amount required. At a station of this kind the average amount of electricity taken by the public was very much less than the capacity of the machines. The reason was that in the mornings and during daylight the electricity was not flowing, and the machines were at rest. The result was that when they specified for machines of an output of 4,000 units what was meant was that those machines were to be capable of producing that quantity for a prolonged time, yet not continuously, and in practice that did not occur. It did occur, but rarely, as in a fog, but otherwise there was a time when the plant was at rest. Therefore, in this case 4,000 KW. was not only sufficient, but more than was necessary for what was required by this company in the course of the day. His learned friends were contending, not for extra capacity, but for extra plant. They wanted six machines instead of four, and they wanted 5,000 KW. instead of 4,000. To justify that claim they said that they must have spare plant. They went on the assumption that they were always and continuously to produce not less than 4,000 KW. all through the day. Now, even if that were going to be done, it could be done with the machines proposed under the terms of this clause. The County Council contended that the meaning of the clause was inclusive of spare plant, while the company contended that it was exclusive of spare plant, and that they were to have not only machinery that would give that 4,000, but spare plant which would produce more, and that they required plant which would produce 5,000 KW. to meet their requirements. The County Council said that the company never had from their station at Sardinia Street so much as 3,650 units. Their plant at that station was a plant the ordinary load of which was 3,650 KW., and that included all spare plant. What they had to give out to the public was very much less, and the 3,650 met all their obligations. It was found by the Committee that there was an increasing demand, and the Committee brought up the requirements to 4,000 units, and the County Council now said that that would give the company all and more than all that they required for re-instatement.

His LORDSHIP: All I am concerned with is the question as to supply and generating, and whether generating and supply mean the same thing.

Mr. HALDANE said that that was so, and that his Lordship required expert information on the subject.

His LORDSHIP: Supposing you had a week's fog.

Mr. HALDANE: Well, they could supply 4,000 KW. continuously and easily. They had their accumulators which could be charged, and even if the plant were not running perfectly smoothly, they could resort to the accumulators.

His LORDSHIP: But there is a limit to their contents.

Mr. HALDANE: Oh yes, but with machinery of this capacity they could supply even without accumulators the necessary 4,000 KW. continuously for a week, or even more. The case for the Council was shortly this—that they asked that it might be declared that according to the true construction of the 55th Section of the London County Council Improvements Act of 1899 they were only bound to pay a sum equal to the cost of fitting up a generating station, and new plant capable of putting out 4,000 KW.; and that according to the true construction of that section, the Council were not bound to pay for plant capable of generating electrical energy to the extent of an output of 5,000 or of anything more than 4,000. The defence proposed that the Council should pay for four high-pressure generators at a cost of £12,000, each producing 1,000 units, and two other high-pressure generators producing 500 KW. each, at a cost of £6,000. The defendants said that they must have spare or extra plant to the extent of 25 per cent. or upwards of the minimum plant necessary to supply their customers. He (Mr. Haldane) hoped to prove that plant such as the County Council proposed to put in of capacity to supply as its normal load 4,000 KW., was really plant which in practice would be used intermittently, and in the case of a station such as this would in the average be used for a much less amount. This plant would be capable of being run for an indefinite time to produce a full normal load of 4,000 KW. In exceptional circumstances it would yield more; but it was plant which was intended to include all spare plant if spare plant were required. That was the contention of the County Council. They contended that their obligation was that they were to pay for a plant intended to cover all the plant, including the spare plant at the old station with its 3,600 KW. Their obligation was to provide this 4,000 KW. on the footing of covering spare plant, if spare plant there ought to be.

His LORDSHIP: It seems really a question of interpretation.

Mr. HALDANE assented, saying that he should have thought the question really was one of the construction of the section. The assistance of the experts was only to enable his Lordship to understand the nature of the machinery, but really there could be nothing except to consider the words of the obligation to construct new plant and machinery for generating and supplying not less than 4,000 KW. Did that imply a contract to furnish in addition what was now claimed as "spare plant"?

His LORDSHIP: It seems to me that it is 4,000 and nothing more, but in a technical sense it may mean something different.

Mr. HALDANE said that of course it might be that there was a custom in the trade, like the baker's dozen.

Mr. BUTCHER questioned the relevancy of admitting evidence in connection with the operations at the existing station. Mr. Haldane had stated that the County Council were to give the company simply what they had before. As a matter of fact, it had been a case of bargaining between the two parties. The Council had been taking away the company's works, forcing the company to go elsewhere. The company on their part demanded *quid pro quo*, and had said that the Council must not take away the company's rights unless something were given that would be satisfactory to them. There was also inconvenience of removing; the possibility of not getting a proper site elsewhere, and all these things were considered in the negotiations between the parties.

His LORDSHIP said that he did not think he need hear evidence on these matters. All he had to consider was the question of plant of a capacity to generate and supply the electrical energy stipulated for. It was immaterial for him to consider what the company had before.

Mr. HALDANE said that in that case he would not go into that general evidence. He would only point out that this was a matter of reinstatement.

His LORDSHIP: Yes; but it is not reinstatement literally, because the company had formerly 3,600, and you are giving them 4,000.

Evidence was then taken, and the first witness called was Mr. CHARLES GADSBY, who, examined by Mr. JENKINS, said he was an electrical engineer at Westminster, and had 18 years practical experience. On the instructions of the London County Council he had inspected the station of the defendant company at Sardinia Street. A 1,000-KW. dynamo, made by a good firm, would stand extra work for a short time—1,250 KW. for a couple of hours. That was exceptional user. They would not expect so to use it for a whole day.

Supposing you have your 1,000-KW. plant in an electrical station, do you say that you can rely on that for any reasonable period to supply the electrical energy at that rate?—Yes. Proceeding, he said that there was usually a margin of one or two machines which could be put into operation when it was necessary to withdraw one of the others for repair. That was a question for the engineer-in-charge, who would use his discretion regarding it. In the case of a station with a single dynamo, if there were to be a spare, they would require to have another dynamo of the same power.

Cross-examined by Mr. BUTCHER, WITNESS said that there were statutory provisions in the case of electric lighting undertakings for giving continuous electrical supply when necessary, and that under penalties. He had designed works for electric lighting in his former capacity as engineer to the Brush Company. He had never had full charge of an electrical station, as he had been more connected with the manufacturers of the plant than with the companies whose stations they were building. In a properly equipped electric lighting station it was usual to have machinery not necessarily running, but in readiness, so as to allow of overhauling and repairing of other machines—a margin of machinery to enable them to carry out repairs and to provide against accidents. Even in fogs in London he did not think that the full supply was required for two or three days continuously. In the early hours of the morning, from one o'clock until four or five, there would be a very much smaller supply required, and in these hours any necessary overhauling of machinery could be effected. In his opinion the plant capacity should exceed the output. There should be machinery by way of reserve to ensure a constant supply of the amount required. The plant capacity was one thing, the output was another; and in well regulated stations the plant capacity was in excess of the output required.

Speaking generally, I put it to you that 50 per cent. is not an unusual amount of spare machinery as compared with the amount of work, or output of energy, required? In the present state of the development of electrical knowledge it is not unusual; the percentage somewhat depends on the timidity of the engineer responsible for the work. But 50 per cent. is not a necessary margin, and I should think that 20 per cent. was nearer the mark.

Mr. ALEXANDER SIEMENS, examined by Mr. HALDANE, said he was a director of the firm of Siemens Bros, and past-president of the Institution of Electrical Engineers. He had had some 30 years' experience in designing and constructing electrical machinery. He had supplied electrical machinery to stations such as the defendant company's. If there came to his firm an order for plant of a capacity to generate and supply electric energy for an output of not less than 4,000 KW., he should understand that the total ordinary full output of the plant was to be 4,000 KW. There might be a difference of opinion as to how it was to be sub-divided; that was a matter of arrangement.

Suppose you had entered into a bargain for a price to supply such machinery, would you consider yourself under an obligation to supply spare plant?—Certainly not. He should not expect that anybody would put 4,000-KW. plant into a station which had to supply anything like 4,000 KW. As manufacturers they only got stated the plant capacity, not the station capacity. The plant which they delivered for the full ordinary load capacity of 4,000 KW. would produce more than 4,000 KW. on an emergency. First rate plant would bear the strain of producing its full ordinary load an indefinite time.

Cross-examined by Mr. BUTCHER: He was a manufacturer of electrical plant. If he were asked to turn out plant to supply 10,000 KW., he would know what was wanted. It was a rule that the plant should be made big enough to enable it to give more. He drew a distinction between plant capacity and station supply for the public. If he had an order to design electric lighting works for the purpose of making a general supply of 10,000 KW., the amount of plant capacity he should supply would depend entirely upon what the station was to be used for.

What I want to know is this. Take the case of an electric lighting station where energy is being supplied for light. You go into the works and see certain plant running?—I might see all the plant running.

You see some of the plant running?—It depends at what time I go in. I might see all the plant running at its full capacity. At the St. James's and Pall Mall you see it.

I suggest to you that the St. James's is at the present moment rather short of plant and they are ordering more?—Most electric lighting companies were in the same position. At London electric

lighting stations, speaking generally, there was no spare plant. He did not agree that in every well-equipped lighting station there was a considerable amount of spare plant. An accident to the plant might, of course, happen, and it was better to have some spare plant.

Supposing the County Council were bound to supply a plant capable of producing a maximum output of 4,000 KW., they would have to supply a plant capable of producing more?—A maximum output is a maximum output. If you want a continuous supply, you would want six times the plant capacity.

I put it to you that electricians are in the habit of allowing 50 per cent. of plant capacity for accident, breakdown, &c.?—I am not aware of it.

Prof. W. E. AYRTON, examined by Mr. JENKINS, said he was a fellow of the Royal Society, past-president of the Institution of Electrical Engineers, and professor of electrical engineering at the Central Technical College. He was familiar with electric lighting in all its branches. It was not possible for an electrical station to have a continuous or uniform output; it varied enormously. It was not usual in electric light stations to have plant called spare plant to meet a contingency. What happened was this; as the demand increased until the maximum output was equal to the total capacity of the plant, when the engineer knew that other customers were coming on in the following year he ordered more plant. That plant would probably arrive in the summer, and then he might have plant which might be called extra or spare plant. During the next winter he might be using the whole of his plant again, and therefore there was no fixed amount of spare plant. There was no distinction between generating and supplying; the dynamos simply generated what they supplied.

Cross-examined by Mr. BUTCHER: In electrical stations in mid-winter at certain times you would generally find all the plant running. At several stations at six in the evening in mid-winter you would probably not find a single dynamo at rest. He had never designed a station, but he knew all about them. He had to teach the designing of stations. They did not have the maximum supplied every day. The maximum in the summer was a very small fraction of the maximum in December. When an accident occurred a company was liable to be prevented from supplying the maximum amount required. Electrical machinery, of course, required at periods to be overhauled. As a rule that was done during the day time, or during the slack period of the year. To overhaul a boiler would take about a day. If a shaft was fractured it would take a long time to repair.

Questioned as to the words, "Plant of a capacity to generate and supply," the WITNESS said he should say that there was no difference between generate and supply, it meant supply at the station. The amount of energy that a company would be paid for, would be rather less than what left the station. There would be a small loss from the mains. He, therefore, thought that the words, "Generate and supply," meant practically the same thing. The dynamos were to generate and give out electrical energy and so on. In this connection it had nothing whatever to do with what customers got.

Is there any fixed relationship between what is produced by the plant, and what is distributed among the customers?—There was not. A small amount of energy was lost in the mains. It depended upon the length of the mains and the system, whether it was high or low pressure. There was no fixed relationship at all.

This evidence closing the plaintiffs' case, Mr. BUTCHER said he would before addressing his Lordship, proceed to call his evidence, and accordingly,

Mr. ROBT. HAMMOND examined, said he was a member of the Institution of Civil Engineers, a member of the Council of the Institution of Electrical Engineers, and a member of the Institution of Mechanical Engineers. He had been engaged in electrical engineering for more than 20 years. He acted as consulting engineer for a number of local authorities. If he were asked to fit up a generating station with plant of a capacity to generate and supply electric energy of not less than 4,000 KW., he should consider it necessary to provide a certain amount of spare plant.

As an expert what do you say the words, "To fit up a new generating station and plant with a capacity to supply electrical energy of not less than 4,000 KW. means." What plant does that involve putting down?—In my opinion that involves putting down a sufficient amount of plant to secure the supply of 4,000 KW. at all periods of the year.

What plant would be requisite for the station?—For a final station for 4,000 KW. I think that provision should be made for sufficient plant to take the place of plant laid off for repairs, and also sufficient plant to take the place of a set of plant which will want or need repair. In designing such a station I should put down six units each of 1,000 KW. That would enable the engineer to have one set of plant entirely removed—both engines and boilers out of commission, leaving 5,000 KW., and then if an accident happened at the time of top load to a machine, there would be a spare plant ready to take on the supply. That was his own practice. The ordinary practice, certainly in laying down new works, was to make a large provision of plant to ensure against a breakdown.

That spare plant was quite distinct from that which might be wanted for increased supply. If you wanted a capacity of 2,000 KW. you must have a plant of the capacity of 3,000 KW. What they had to provide against was an unexpected breakdown which might occur at any moment.

Cross-examined by Mr. HALDANE: He had given a good deal of advice in the designing of stations. He had made plant, but did not make it now.

In providing for the supply of your lamps, do you make provision on the assumption that the whole of the lamps are going at once?—Oh, no; not the whole.

What proportion do you take?—The proportion varies very considerably in different districts; one usually reckons about 60 per cent. or 63 per cent. in the London districts. In a district where there are many theatres, and where there is a constant load, you would get a higher ratio than you would in a district where there are only private houses, where, when they leave the dining room, they turn out the lights.

Mr. HALDANE: I have known the lights to be left on all night But that was no doubt either by the diligent or the dissolute.

Cross-examination continued: It was always necessary to have sufficient plant to provide against emergencies.

Mr. SEBASTIAN DE FERRANTI, examined by Mr. SARGEANT, said he was a member of the Council of the Institution of Electrical Engineers, a member of the Institution of Civil Engineers, and a member of the Institution of Mechanical Engineers. He was a manufacturer of machinery for electric lighting.

Assuming that you were asked to fit up a new generating station and new plant of a capacity to supply electrical energy to the extent of 4,000 KW., what plant would you consider it necessary to lay down for that purpose?—I should consider the best way to do it would be to put down four plants of 1,000 KW. each to supply the demand, and I should then require another plant to act as a standby.

Cross-examined: Speaking from his experience, that was the usual custom at the most successful central stations. There were some that did not follow that principle, perhaps. If he got an order for a machine of the capacity of 4,000 KW., he should provide a machine of that capacity, but he did not think the purchaser would expect to give light to the public up to the full registered capacity marked on the machine.

Sir WM. PREECE, examined by Mr. SERGEANT, said he was consulting engineer to the Post Office and other public bodies.

Assuming you were asked to advise a company as to erecting a new generating station with new plant of a capacity to supply and generate electrical energy of not less than 4,000 KW., what plant would you advise the company to lay down?—I should advise a plant of 6,000 KW. It was necessary to have a spare plant for public supply for contingencies.

Mr. HAROLD DICKINSON, an electrical and mechanical engineer, corroborated generally the evidence of the last witness.

COUNSEL then addressed his Lordship on the law, and the hearing was adjourned till Thursday.

Mr. Justice FARWELL, in giving judgment, said that the London County Council, under the provisions of their Act of 1899, were making a new street leading from Holborn to the Strand, and under the powers contained in their Act, they had taken the premises belonging to the defendant company, situate in Sardinia Street. The defendant company had there a generating station, from which they supplied their district surrounding. The Act in question contained a section providing for compensation to be paid to the defendant company by the plaintiffs for taking their premises and displacing them. His Lordship thought that the determination of the question in dispute depended upon the construction of that section. The defendant company had this station as a generating station, and they had acquired and intended in future to use in addition a generating station at Willesden for transmitting energy to their station in London if necessary and transforming there, and accordingly a provision was made in the section and sub-section for that purpose. Under the provisions of the section the County Council had to provide a site on which the defendants should be able to reinstate their buildings, machinery and works, and there was a certain power in the defendant company to purchase the freehold interest if they accepted from the County Council the lease which they held in the land taken from the County Council. The value of the section, which, after all, was an agreement between the parties confirmed by the Legislature, was this. The defendant company was to be compensated by being put as nearly as possible in the same position as before the Council displaced them. They were to have a site provided by the Council adjacent to the site from which they were displaced. Although the site was definitely fixed for that purpose there was in one sense an element of indefiniteness, because the defendant company might change their minds as to the position. The defendant company contemplated not merely replacing their generating station, but having a larger station for generating as formerly, and for transforming and transmitting from such transformers. His Lordship then referred to the sections in the Act of 1899 bearing on the dispute, and said that the matter as to the compensation to be paid by the London County Council to the defendants was to be settled by arbitration under the Lands Clauses Act. An arbitrator had been appointed, and the Council came to the Court asking for a declaration for the guidance of the arbitrator as to the basis on which he should assess the sum to be paid for compensation, and that depended upon the construction to be put upon the words of Sub-section 7 of the Act. The question was whether the generating station was to be of a certain capacity and so on, or whether it was to have a plant of a certain capacity and so on. He came to the conclusion on the evidence that the generators were made so as to leave a small margin of possible supply in case of need. According to the plaintiffs' witnesses that to have a station which was effectual to supply 10,000 KW. it was necessary to have a plant in that station of a greater capacity than 10,000 KW. The claim by the defendants was in effect not for 4,000 KW. machinery, but for 6,000 KW. machinery. His Lordship, having referred to the evidence generally, said he came to the conclusion that what was intended was that the generators—plant and machinery—should be of a capacity to generate and supply energy of not less than 4,000 KW., and not that the station should be a station which, according to the advice of possibly conflicting experts, would have to be fitted up in accordance with experts' opinion as to what was desirable for a 4,000-KW. station. That disposed of the case.

Mr. Haldane, referring to the costs, said that the motion which was formerly before the Court was ordered to stand till the trial. He thought the declaration covered what he wanted.

His Lordship: Yes, the negative part. I think I had better make the costs of the motion costs in the action.

Mr. Cripps: Will your Lordship make the costs of the action costs in the arbitration?

His Lordship thought he could not do that He suggested to Mr. Haldane that there should be no costs.

Mr. Haldane strenuously objected to there being an order of no costs of the action. His learned friend was claiming to go to arbitration on a basis which his Lordship had held was wrong. The question which was involved was determined before they got to arbitration at all. The County Council had succeeded on a point which saved them £50,000.

After some further discussion, his Lordship thought that the plaintiffs were entitled to have their costs of the action and of the motion.

London Electric Supply Corporation, Limited *v.* Saunders.

This was a claim for £17 9s. 7d. for electricity supplied, brought before his Honour Judge Lumley Smith, K.C., in the Westminster County Court on Monday, against the defendant, a surveyor, of Adelphi Terrace, Strand, W.C., and he counterclaimed 50 guineas damages for breach of agreement to supply him with light. Mr. Ashworth Harrison was counsel for the plaintiffs, and the defendant appeared in person.

Mr. Harrison understood the claim was not disputed, and submitted the defendant's remedy, if he had any ground of action, was in the Police Court so far as his counterclaim was concerned. He wanted damages because he said plaintiffs had failed to supply him with light, and for that he must seek to have the penalty, a fine up to 40s., enforced in the Police Court.

His Honour: I suppose if you supplied no electricity you could not recover.

Mr. Harrison said the claim was for light supplied, and defendant wanted 50 guineas damages, and charged the plaintiffs £3 15s. for the purchase of lamps, oil, and candles. He had entered defence before when sued, but had always paid.

Edward Flood, inspector in the plaintiffs' service, said he visited the premises, and found the meter registered 777 units. For that £16 3s. 9d. was charged, and £1 5s. 10d. meter rent made up the claim.

Cross-examined: The meter was now removed. Was prepared to say at what voltage the current was supplied. The pressure was 100 to 105 volts.

Defendant said his complaint was that he had either had no light or so indifferent a light that it was of no use for illuminating purposes. It had gone out for various periods, from minutes to a day and a night, and he had had to resort to other illuminating powers to carry on his business. On those grounds he resisted this claim and sought to recover damages.

Mr. Harrison: Do you admit signing the contract?—Yes.

Mr. Harrison: Then I put that in and submit his remedy is at the Police Court.

Defendant submitted he could go for penalties or resist the claim. He chose to resist the claim because it was cheaper.

His Honour decided to hear defendant's case without stating any opinion on that point.

Defendant then deposed that he lived and had his offices at Adelphi Terrace and entered into a contract with the plaintiffs under which they were to supply him with electric light. What they did supply him with was an inferior light which failed, on an average, say, once a week. Sometimes it went out, generally for short periods, but for as long on one occasion as two nights and a day. The quality of the light was bad and he often could not read by it. It consisted sometimes of nothing but a red wire in the lamps. Plaintiffs had acknowledged their shortcomings in a circular letter he produced which he received in November, 1899.

His Honour read the letter, and said plaintiffs said they were very sorry, but it was not their fault as they could not get their plant. Had he had reason for complaining since the receipt of that letter?

Defendant said he had to complain up to when he was cut off last September. The Savage Club, too, had to give the light up. It was very inferior, but the meter went on registering it.

Cross-examined: It was about six years ago that he entered into the contract, and he had constantly complained about the light. He had to provide his own lamps and they were of the best sort. When sued by the plaintiffs before, he had given notice of this defence, but judgment had been given against him, but by default, as he had not been able to appear. He had made no application after to have the matter reopened. In answer to the Judge, he said his eyes had been severely strained and he had suffered severe loss. Had given plaintiffs up now, and was well supplied by the Strand Company.

James Berryman, solicitor's managing clerk, said he often called at defendant's on business, and corroborated as to the failure of the light.

Wm. Mitchison, surveyor's managing clerk, gave similar evidence, and, in cross-examination, said he knew nothing about electricity, but volunteered the statement that, in his opinion, the wavering of the light was caused by there being something wrong with the dynamos.

Defendant contended plaintiffs had broken the contract to supply him with electricity.

His Honour said "the undertakers," the order stated, "shall give, and continue to give," a supply. The reason, he thought, for the 40s. penalty was to meet a case where the damages could not be put into money.

Mr. Harrison called rebutting evidence.

Ernest Rowe, inspector in plaintiffs' service, said the meter would not go on registering when the light failed. If there was a bad light the meter would not register the same as if there was a good light. He had been with the plaintiffs for ten years, and never knew the light to go out for two nights and a day. He knew of no complaints, and defendant's tenants in the same building were still using the light.

Cross-examined: Had the registers in Court. There were 23 of them, and they would take about a week to go through.

Defendant: Well, let us take a week at random, say, October, 1899.

Mr. Harrison: At random. That is just before that letter of apology.

The Witness produced the engineer's report book from the chief station for the period referred to, and the Judge examined it and said the voltage was 106.

Defendant: That is too high, 100 is right.

His Honour: People living near the station sometimes get too much, and those living further too little.

Defendant said mains ran through his premises.

Witness was not aware that any mains ran through his premises except for himself and his tenants.

Defendant: Are you aware that I paid for the Royal National Lifeboat Institution and my own as well, and that you also charged them?—I was not aware of that.

Defendant said that was a matter of a £16 overcharge. Plaintiffs charged the institution and himself, and their light was therefore paid for twice over.

Mr. Harrison: We rectified that.

Defendant said he wished to show what mistakes were made, and that this witness did not appear to know much about it. In answer to the Judge, he said he asked for something fair and liberal.

His Honour: How much? You claim 50 guineas.

Defendant: I say 50 guineas would not pay me, but I think it fair to set one against the other. I simply want to wipe off the claim against me.

His Honour: It seems to me the 40s. penalty is for where a man asks for a supply and you don't give it to him. I am going to allow him 40s.

Defendant: They offered me £4.

His Honour: You had better have taken it.

Judgment was entered for the plaintiffs for £15 9s. 7d, with costs.

Wood *v.* The National Telephone Company.

In the Chancery Division of the High Court of Justice, on Friday, April 26th, before Mr. Justice Byrne, counsel stated that this was a motion for an injunction to restrain the defendants from trespassing on the plaintiff's property. The defendants had agreed to treat the motion as the trial of the action, to submit to a perpetual injunction (the operation of the injunction to be suspended for three months), to pay the plaintiff's costs as between solicitor and client, and ten guineas damages. Order accordingly.

Crow *v.* The Board of Works for the District of Whitechapel.

In a specially constituted court of King's Bench, composed of Justices Grantham, Kennedy, and Darling, the hearing was resumed of the case of Crow *v.* The Board of Works for the District of Whitechapel, on Saturday, the 27th ult. This case was argued before Mr. Justice Kennedy and Mr. Justice Darling last December, but their Lordships then disagreed, and the case now came on for a re-hearing before an additional judge—Mr. Justice Grantham.

This was the defendants' appeal from a decision of Mr. Dickinson, the magistrate sitting at the Thames Police Court in June last. It appeared that a summons was taken out by Mr. Crow, the district surveyor, against the defendants, for not having given him notice under Sec. 145 of the London Building Act, 1894, before commencing the construction of a number of boxes, or inspection chambers, under the streets in the district for the purpose of electric lighting. The defendants were the local authority within the meaning of the Electric Lighting Acts, 1882 and 1888, for the district, and in the year 1892 were granted by the Board of Trade, pursuant to the Electric Lighting Acts, 1882 and 1888, in respect of such district, a provisional order, called the Whitechapel District Electric Supply Order, 1892, which was afterwards confirmed, and came into force on June 27th, 1892. By Secs. 11 and 12 of this order the "undertakers" were authorised to construct in any street any such boxes as might be necessary for purposes in connection with the supply of electric energy, including apparatus for the proper ventilation of such boxes. The sections further provided that "every such box shall be for the exclusive use of the undertakers, and under their sole control, except so far as the Board of Trade may otherwise order, and shall be used by the undertakers only for the purpose of leading-off service lines and other distributing conductors, or for examining, testing, regulating, measuring, directing, or controlling the supply of energy, or for examining or testing the conditions of the mains or other portions of the works, or for other like purposes connected with the undertaking, and the undertakers may place therein meters, switches and other suitable and proper apparatus for any of the above purposes. Every such box, including the upper surface or covering thereof,

shall be constructed of such materials, and shall be constructed and maintained by the undertakers in such manner as not to be a source of danger, whether by reason of inequality of surface or otherwise." Sec. 12 further provided that the undertakers should, one month before the commencement of such works, serve a notice upon the Postmaster-General, describing the proposed works, together with a plan of the proposed works, and in addition a like notice and plan upon the County Council. The defendants did not, before commencing the construction of the boxes, serve Mr. Crow with notice of the intended work, under Sec. 145 of the London Building Act, 1894. Mr. Crow's contention was that the boxes came within the definition of "building structure or work" in Sec. 145, and that the defendants were bound, before commencing the work, to serve upon him, as the district surveyor, a "building notice," as prescribed by the section. The defendants contended that the Act of 1894 did not apply at all to boxes constructed in the streets under the provisional order, inasmuch as the order contained a complete code regulating the materials, situation, and mode of construction of such boxes, and provided a complete machinery for enforcing such regulations, with which special code and machinery the London Building Act of 1894 was inconsistent. The magistrate found, as a fact, that the boxes so constructed were "buildings, structures, or works" within the meaning of Sec. 145 of the London Building Act, 1894, and having regard to Secs. 72, 201, and 203 of the said Act, he held that the provisions of Secs. 145 were not inconsistent with the special Act, and imposed on the defendants the nominal penalty of 1s., and ordered them to pay £10 10s. costs—hence the present appeal of the defendants. Mr. Dickens, K.C., and Mr. Talbot appeared for the appellants (defendants), and Mr. Horace Avory, K.C., for the respondent (plaintiff).

At the conclusion of the arguments their Lordships reserved judgment.

Hawkes *v.* Leyton Urban District Council.

This case came on for hearing on 25th ult. by Mr. Justice Buckley in the Chancery Division of the High Courts of Justice. It was a motion by the plaintiff, Elijah Hawkes, to sequestrate the Urban District Council of Leyton for breach of an order made by the Court on February, 1900, restraining the defendants, their servants and agents, from carrying on their electric supply works at Leytonstone so as to cause a nuisance, by noise and vibration, to the plaintiff as owner and occupier of premises in the Cathall Road, where the works are situated.

Mr. Astbury, K.C., who appeared for the plaintiff, explained that when the case was last before him his Lordship came to the conclusion that the gas engines in the defendants' works required very careful watching to prevent them becoming a nuisance. Defendants undertook to stop the "back-firing" in the exhaust pipes and explosions as far as possible, and not to run the engines between the hours of 11 o'clock at night and 7 o'clock in the morning. Mr. Astbury read affidavits of a number of persons, in which they represented that notwithstanding the injunction the nuisance still existed, and various dates were given on which they experienced excessive noise and vibration. Frequently they had been disturbed in rest at night owing to the working of the engines, the vibration being so bad as to make the windows of their houses rattle, and loud explosions were frequently heard, these being caused by the back-firing of the engines. It was also contended by Mr. Astbury that the gas engines had been kept running after 11 o'clock at night.

Mr. H. Terrell, K.C., for the defendants, maintained that the alterations made at the works had the result of remedying any nuisance, and the engines, excepting on one or two occasions, were not run after 11 o'clock at night or before 7 o'clock. He would call witnesses who lived near the works, and who had never experienced any annoyance. Others since the date of the injunction had never heard any back-firing of the gas engines. One witness, who lived 375 feet from the works, said his sleep was in no way affected by the engines, but considerable vibration was occasioned by numerous trains passing to and fro.

The hearing of witnesses was afterwards proceeded with, and the case was adjourned.

The hearing of this case was concluded before Mr. Justice Buckley, in the Chancery Division of the High Court of Justice. The learned Judge found for the plaintiff. It was his duty to see that the orders of the Court were obeyed, and when persons had the assurance to tell the Court that after giving an undertaking they deliberately proceeded to break it, he had no alternative but to visit them with the consequences. The only point upon which he had any doubt as to conflict of evidence, was the question whether or not some of the witnesses were correct in saying they heard vibrations at midnight and in the early hours of the morning. He rejected as ridiculous and absurd the suggestions that had been made that the explosions heard by the witnesses for the plaintiff were caused by the shunting at a station a mile away, or that the explosions were due to fog signals along the line. He did not feel himself under the necessity of arriving at a distinct conclusion as to the point of whether the witnesses were mistaken in saying that they heard explosions at 3 o'clock in the morning. If he had felt it necessary to do so he should not have found that the log sheets showed that the engines did not run after midnight. These log sheets were untruthful in some respects, and all the back-firing was not recorded in them. The nuisance caused by explosion and vibration, which he found to exist at the trial, still continued to exist. He, therefore, came to the conclusion that the defendants had not obeyed, had not tried to obey, and had never intended to obey, the orders which were made. In dealing with a public body of that sort, if it were proved that, owing to some sudden accident or pressure, they had committed what was, in point of fact, a breach of the order, he would take that into consideration. In this case he did not find anything of the kind. The defendants deliberately disobeyed the order of the Court, and did not seek to apply to be relieved from any strain in which they might have been placed by the injunction. Accordingly he granted the motion of plaintiff, and found him entitled to costs.

Callender's Cable Company *v.* Killarney Electric Lighting Company.

On April 23rd in Chancery Division, Dublin, before the Master of the Rolls, in this case, Mr. Sandford applied on behalf of the defendants for an order that Mr. Thomas C. Goodman, Sub-Sheriff of County Kerry, who was appointed Receiver, should be authorised to collect all sums due to the defendant company, and to pay the wages and other necessary outgoings of the company under the direction of the directors. The defendants wanted to do what they could to preserve the property.

Mr. P. O'C. White, for the plaintiffs, asked that the motion should be either refused or allowed to stand till the hearing of the action, when the whole question as to the appointment of manager could be discussed. It was owing to the denial by the defendants of the due issue of their debentures that the case had not been ready for trial. If the company admitted due execution of the debentures they could go to trial at once. The plaintiffs were creditors to the extent of £1,300 or £1,400, and they alleged that the business of the defendants had been mismanaged by the directors, and that the books did not show the true financial state of the company at all. Twenty writs had been issued during the year by creditors against the defendants, and five executions had been issued on foot of judgments obtained. These executions had been put in the hands of Mr. Goodman. The defendants owed nearly £2,000, and £80 for wages. The debentures were altogether about £7,000.

The Master of the Rolls said he observed Mr. Goodman appeared in several capacities in the case. He granted the order asked by Mr. Sandford, and would (says the *Irish Independent*) authorise Mr. Goodman to make the necessary payments after conference with the directors.

Fitzgerald *v.* Dublin United Tramways Company.

This case was before the Lord Chief Baron, Mr. Justice Murphy, Mr. Justice Johnson, and Mr. Justice Kenny in the King's Bench Division at Dublin last week. It was a motion on behalf of the defendants for an order that the verdict and judgment for £1,000 entered for the plaintiff, Mr. Martin Fitzgerald, of Pembroke Road, Dublin, be set aside, or a new trial granted, upon the ground that improper questions were left to the jury, and on the ground of misdirection and wrong direction. The real question was whether the non-sanding of the streets, which was the cause of the accident, was the default of the Corporation of Dublin or of the defendants. Mr. Ronan, K.C., and Mr. W. Q. Murphy (instructed by Messrs. Casey and Clay, solicitors) appeared for the defendants, and asked for an adjournment to enable them to have the assistance of Mr. Gordon and the Attorney-General, who were in England. Serjeant Dodd, Mr. O'Shaughnessy, K.C., and Mr. Powell (instructed by Mr. James Fitzgerald, solicitor), appeared for the plaintiff. The Court adjourned the motion for one week.

PARLIAMENTARY COMMITTEES.

Chester Tramways.

Earl Morley's Committee of the House of Lords on Monday considered the Chester Corporation's Tramway Bill, which came up as an unopposed measure. Under this Bill power is asked to reconstruct the existing tramways in the city for mechanical traction, and also to construct additional tramways in and adjacent to the city. The only tramways proposed to be constructed outside the city are to Great Broughton and Saltney, in the counties of Chester and Flint respectively. The preamble of the Bill was found to have been proved, but some of the clauses were left over for future consideration.

London County Council Tramways.

The Court of Referees of the House of Commons, presided over by Mr. Parker Smith, had before it on Monday the consideration of the Tramways and Street Widenings Bills of the L.C.C. Under the Bill the Council asked for power to construct a new line from the Lambeth Road, across Westminster Bridge Road, along York Road and Stamford Street, across Waterloo Bridge Road and Blackfriars Road, through Southwark Street to the Southwark Bridge Road. It is also proposed to acquire land near the Camberwell New Road station of the L.C. & D. Railway on which to erect a large electric generating station in connection with their scheme for working their trams by electricity. The Council objected to the *locus standi* of six of the petitioners, including the claims of the South-Eastern and Chatham and Dover Railway Companies, who wished to be heard against the Southwark Street portion of the proposed new line. Mr.

Pember, K.C., on behalf of the railway companies, said that their goods stations at Blackfriars was entered from Southwark Street, and the construction of the proposed line would lead to the blocking of that street, and of the entrances to their station, to and from which no fewer than 13,000 wagons proceeded every day. They also alleged that the new line would compete with their local traffic between London Bridge and Charing Cross, and that the proposed line to Lordship Lane would compete with their suburban traffic. After hearing Mr. Du Cane on behalf of the L.C.C., the Court decided to allow the petitioner's *locus* as frontagers in regard to one of the propositions of the Council, and with reference to competition in connection with another proposal. The Catholic Apostolic Church in the Camberwell New Road also applied for a *locus*, on the ground that the excavations in connection with the generating station might affect the stability of the structure. After hearing counsel, the Court disallowed the *locus*.

Bury Tramways.

On Monday the Examiners of Standing Orders of the House of Commons found that the second reading orders had been complied with in the case of the Bury Tramways Bill, which provides for the construction of additional tramways which are to cost together with street improvements, £132,000. The Bill was ordered to be reported for second reading.

Cleveland and Durham Electric Power Bill.

A Select Committee of the House of Commons, presided over by Sir Wm. Houldsworth, commenced the consideration of the above Bill on Thursday last. There were a large number of opponents to the Bill, including the Darlington Town Council, the West Hartlepool Corporation, the Middlesborough Corporation, the Hartlepool Town Council, the Stockton Town Council, Thornaby-on-Tees Town Council, the Tees Conservancy Board, the Stockton-on-Tees Bridge Board, the Sunderland and South Shields Water Company, &c. Mr. Balfour Browne, K.C., Mr. C. A. Russell, K.C., Mr. H. Lloyd and Mr. Devonshire appeared for the promoters.

Mr. Balfour Browne, in opening the case, first referred to the past history of the laws regarding electric lighting, and said that last year there were four Bills before Parliament which were analogous to the one now before the Committee. All four of these Bills had passed into law. The present Bill was promoted by local men very greatly interested in the industries of the district. They included Mr. E. L. Pease, Mr. A. F. Pease, Mr. H. P. Pease, and Sir T. Wrightson, and the capital involved in the concern with which the promoters were connected was £14,834,000. These gentlemen to a large extent would be large consumers of the electricity to be generated, and they would provide every farthing of the money necessary to promote the Bill, and there was no financier working between promoters and the customers. The only object of the Bill was to secure electricity at as cheap a rate as possible, and the only way in which this could be done was to produce it upon a large scale in a convenient position, and by very powerful machinery. But although he had all the great people of the district at his back, he told the Committee that the Bill would be more advantageous to the poor man and the small manufacturer than to the rich. They were not really asking for much; all they were asking was leave to break up streets and roads in order to distribute electricity to the manufacturers, but to a considerable extent they would not have to break up roads. It was believed that when the company got into full working order they would show a very substantial dividend on the large capital involved. The area to be covered by the undertaking was 820 square miles. South of River Tees would be covered—the Cleveland district, where there were great ironstone mines and ironworks. It was a very rich district, and would require an enormous amount of power, and that the company proposed to supply. He might mention that a local company applied to the Darlington Corporation for electric power, but the terms were such that the company decided to erect works for themselves, as they could manufacture it more cheaply than the Corporation could supply. Under such circumstances as that he certainly objected to the opposition of the Darlington Corporation to the Bill. The Middlesborough Corporation had the power to supply electricity, and had about 300 customers, while the Darlington Corporation had just started. Both Barnard Castle and Bishop Auckland had got powers, but were not supplying. West Hartlepool did supply, and had 260 customers; while Hartlepool had an order, but was only using it for tramways. Stockton was just supplying; Redcar, Ormesley, and Spennymoor all had powers, but were not supplying, while Saltburn was running an electrical installation without statutory powers. In the whole area there were only 560 customers, with a population of upwards of 750,000. The average price now charged was 4½d. per Board of Trade unit, but the promoters would be able to supply at something like 1½d. per unit with anything like a large consumption and a good load factor. It was estimated that the total number of collieries, factories and quarries was 369, and he ventured to say the Committee would consider it a suitable district for such a supply, especially when they found the manufacturers coming forward to say that they wanted it. With regard to the petitions against the Bill, he considered that it was both unjust and short-sighted for the local authorities to try and force their dear wares on manufacturers. It was a monstrous attempt on the part of those bodies to demand a veto from Parliament which under the circumstances ought not to be given. There were 52 petitions in favour of the Bill representing many millions of capital, and these petitioners were local men and not speculators. In the district there were six boroughs, 23 urban district councils, and 20 rural district councils. He asked that the Committee should allow, if necessary, the promoters even to compete with the opposition, safeguarded as the Bill was by the necessary consent of the Board of Trade.

Mr. Hugh Bell, one of the promoters, was called, and expressed the opinion that the district could be economically supplied with electric energy generated in six or seven generating stations. He did not see how it was possible for the corporations in the district to supply electric energy such as was required.

Mr. S. Z. de Ferranti, electrical engineer, said he had a large experience in the building of the plant necessary for power undertakings, and had given evidence before Parliamentary Committees on the subject. He considered that the suggestions in the Bill would be a benefit to the locality. The production of power was quite a business in itself, and to produce it economically required a particular knowledge, and it was better for a large concern to take their power from a company which made it their business to make electricity than to sink their own capital in generating it for themselves. There would be considerable waste as a rule in making the power for oneself, and it was much to the advantage of manufacturers to be able to get sufficient for their purposes at a known price.

Replying to a question by the Chairman, the Witness said it was it was quite true that there was some loss in the transmission of current from a large generating station to various works, but as against that there was a saving in generating on a large scale and relieving the manufacturer from making his own electric supply. The loss might be about 10 per cent. in the year. The loss would increase as the distance increased, but the most important thing in favour of a large generating station was what was known as a diversity of demand, which enabled a large company to supply electricity to a large number of customers better than could be supplied them from a small station. While it might be worth the while of a large manufacturer to put down his own plant, it was hardly worth while for a small manufacturer to have his own generating station. There was no doubt but that a large number of manufacturers were precluded from using electricity because they could not buy it cheaply, and could not provide the capital expenditure for putting down their own plant.

By the Chairman: It would be competent for any person taking their power to use it for electric lighting purposes, but it would first have to go through a motor-generator. It would then be possible to regulate the current so that a certain amount of lighting could be done with it.

By Mr. Crombie (a member of the Committee): To do this a man would have to put down certain machinery, but it would then be more economical than taking it from a local authority. If a local authority took the current from the company and converted it for lighting, that might do if they supplied it at a cheap rate.

Further examined, Witness said he would much rather have a large area and a greater certainty of demand than a small area like Middlesborough, for instance. It was difficult to say whether it would pay the company to have the custom of small consumers, but there were a large number of works where they used 50 h.p., and they would benefit by the supply of the company. On the other hand, those with 10 h.p. could be supplied by the local authorities, and, in fact, were now being so supplied, although the price could not be so low as to large consumers. He saw no engineering difficulty in the scheme.

In cross-examination by counsel for the Hartlepool Corporation, Witness said the company did not propose to compete for the supply of the small shopkeepers who could be supplied by the Corporation, but he did not admit that they wished to come in and take the plums, because the large consumers could not be called the plums in a sense, inasmuch as if the Corporation wished to supply them they would have to put down a special installation. They would have to supply small people under certain conditions, but the company did not want the small customer who was advantageous to the Corporation. He took it that they would be bound to supply any customer who came to them.

The Chairman said the company could not go to Hartlepool without the consent of the Corporation.

Counsel said that was so, but they could come in and supply one customer under an arbitration.

Witness said the company proposed to supply the three-phase low-tension alternating current, and that would not do for electric lighting direct, but it was more suitable for motive power where motive power was the principal business.

In answer to a question by the Chairman, Counsel said that the Hartlepool Corporation had begun their electric light works, but had not commenced the supply. Their order was 18 months old.

By Mr. Acworth (representing the Middlesborough Corporation). The idea was not to supply all the big people and leave the little ones to the Corporation. What they wanted to do was to supply those whom the Corporation had not laid themselves out to supply.

In reply to Mr. Shortt (representing the Darlington Corporation), Witness said he could not say off-hand at what price it would pay the company to supply Darlington. It would not be obstructive for a Corporation to offer to supply a 200 h.p. consumer with 300,000 units at 1½d. per unit, with a charge only of 5½ per cent. on the expenditure, provided the Corporation did not keep other people out who could do it at a better price. He thought it would be a good thing if the Corporation of Darlington were to purchase the tramways and convert them into electric tramways. He thought it would be a fair *proviso* to put in the Bill that the Corporation should have the power of supplying large consumers first, provided that they did not handicap the business.

Mr. Russell, in reply to the Chairman, said that by the South Wales Bill of last session, the promoters had power to go direct to the consumer, though not to go into the district of any distributor without his consent.

Witness failed to see how the middleman could be an advantage to the consumer.

Mr. E. Lloyd Pease, director of Messrs. Pease & Co., coal owners, one of the promoters of the Bill, said he did not anticipate any difficulty in financing the scheme. At his works at Middlesbrough they were putting down a plant to supply themselves, and it depended on the price charged by the company whether they supplemented their supply from the company, or extended their own plant. If there was any idea that the Bill would injure the local authorities, they would not have promoted it, but he thought they would take up different classes of business.

Mr. Stobr, secretary of Messrs. Bolckow, Vaughan & Co., the largest iron and coal company in Great Britain, gave evidence in support of the Bill. At present the company were erecting a generating station of their own at South Bank, Middlesbrough, but had the promoting company been in existence when they decided on that, the capital expenditure would probably have been unnecessary. The generating station would only be adapted for supply to a certain portion of their blast furnaces, and their works in other portions of the district would still be without an electric supply. The provision of electric power by such a company would be an enormous benefit to such an undertaking as the one he represented.

Mr. W. Johnson, director of Bell Bros., Limited, chairman of the Middlesbrough Chamber of Commerce, and a member of the Cleveland Chamber of Commerce, and the Cleveland Mine Owners' Association, said all those bodies would be glad to be able to obtain electrical power either from the local authorities or the company.

By Mr. Shortt: They would be prepared to take power as fast as they could get it either from the corporations or the company.

Sir T. Wrightson, M.P., said there was at present no electric light installation at Thornaby, where his firm employed 1,000 men, and they suffered from foreign competition in consequence of the absence of a cheap form of power. He considered that the supply of light and power belonged to two entirely different categories, and that while light should be supplied by the local authority, the supply of large quantities should be done by private enterprise. He had no doubt about the capital being forthcoming.

In cross-examination, Witness said he did not consider it desirable that a Corporation should supply power as well as light, because there were risks attending the supply of power which were not experienced in the supply of light.

Mr. C. Bagley, managing director of the Durham Steel and Iron Company, employing 5,000 hands, regarded the supply of energy by the company as proposed as a great boon to the industrial interests of the neighbourhood, and considered that it ought to be furnished by private enterprise. Five years ago his company applied to the Stockton Corporation for a supply of energy for lighting purposes, and the Corporation delayed so long that his company laid down their own installation. Two years ago they applied to the Corporation for a supply of energy for power, but the conditions were such that the company could not agree to them. The company required from 800 to 1,000 H.P., and the Corporation offered to supply a maximum of 200 H.P. at 2½d. per unit for a minimum payment of £150 a quarter, the company to provide the cable and lay it underground for half a mile in the public roads, which the company, as a matter of fact, had no power to do. As a result, the company had determined to have their own installation for power, but they would prefer taking it from the company.

Mr. Walter Norman, managing director of the firm of Messrs. R. Stevenson & Co., Darlington, stated that last year his company was approached by the Corporation on the subject of taking power, but the terms were too high, and the company determined to put down their own installation. It was most likely that if the promoting company had been in existence they would have gone to them.

Mr. C. Lugard said that last year he applied to the Stockton Corporation for a 50-H.P. electrical supply day and night, but the Corporation did not care to lay the mains.

Mr. Lankester, counsel for the Corporation, said he was instructed that no one in authority had instructions to refuse to supply the witness. As a matter of fact, they were now laying a main past his door.

On Monday, Mr. Greener, colliery manager to Messrs. Pease and Partners, Limited, said their horse-power was 7,887, raised by steam. They would gladly welcome a supply of electric power from the promoters. He had been told by the promoters that they could give him the power at a cheaper rate than he was now generating it at.

Mr. G. T. Hyden, chairman of the Consett District Urban Council, supported the Bill. The reason they favoured the Bill was that under it they would be able to get an electric supply, which they could not provide for themselves, and ultimately it might lead to the adoption of electric tramways.

Mr. G. Hobbs, secretary of the Cleveland Miners' Association, supported the Bill on behalf of the Association. They thought the provision of electric power in ironstone works and mines was likely to add to the comfort and health of the workpeople, and that an electrical supply was necessary for the development of the district.

Mr. H. G. Harris, engineer, of Westminster, partner of Sir F. Bramwell, said the Bill was intended to be identical with the South Wales Bill of last session. In Middlesbrough the Bill was supported by capital invested in works to the extent of nearly 3½ millions. So far, Middlesbrough only intended to put down 36,000 H.P., and he considered the opposition to the measure absurd. Middlesbrough had probably got in its area some 33,000 or 35,000 H.P. Darlington had installed two engines of 50 I.H.P. and two engines of 150 I.H.P.; West Hartlepool had installed 600 I.H.P.; Stockton 500 H.P. Saltburn was supplying, but without statutory powers. The total areas in which there were powers of supply was 33 square miles out of the 820 square miles comprised in the district, and the total number of customers supplied last year was 560. The total horse-power installed in the area for tramways and general supply was estimated at 4,200 H.P., but there was money enough in the Bill to provide for an installation of 40,000 H.P. The promoters themselves would practically require 40,000 electrical H.P. in their works. They were not asking for enough capital for the whole works if it developed. The share capital was £1,000,000, and they had power to borrow a third, and they must borrow as the shares were issued.

In cross-examination, Witness said he was not satisfied that it would be profitable for the Corporations to attempt to supply this power. It was intended to build the generating stations at Consett, Witton Park and Haverton Hill first, and when they were called upon to supply Darlington they would probably be in possession of a generating station at Aycliffe.

On Tuesday Mr. Harris, engineer, was recalled, and corrected a statement regarding the amount of horse-power used now by the promoters of the Bill. The correct figure was 43,200 H.P.

In cross-examination, he said he could not give details as to the consumers of more than 100 H.P. or of less than 50 H.P. It was impossible for him to draw a dividing line up to which corporations ought to be allowed to supply. It was true that if local authorities were supplied by the company in bulk they would still require to provide generating stations and have staffs. They proposed under the Bill to supply a high pressure current at 6,000 volts. They would have to get a further relaxation as to the pressure of the current to be delivered on to the premises of consumers, and they trusted they would get the concession up to 10,000 volts. He did not, of course, mean the definition of "premises" to apply to small shops, but to large concerns such as those belonging to the promoters of the Bill where from 1,000 to 2,000 H.P. would be used. As a matter of fact, it would make little difference to the consumers if the Board of Trade did not grant the concession, although if it were granted it would make it a little cheaper. If the Board of Trade did not allow them to depart from the existing regulations, then they would have to transform, and in that case the capital cost of the transformers would have to be added. This would cost from £3 to £4 per horse-power. The company could not give anything in the way of undue preference to customers. They were subject to revision by the Board of Trade, and many other precautions were taken to ensure that the local authorities should have all the advantages which could be properly reaped under the scheme.

By Mr. Loder (a member of the Committee): There was an area included in the Bill which was a mutual area with the Durham Company, and the reason this was included was because several of the works of the promoters were in the district which could not be supplied by the Durham Company. By arrangement with the Durham Company they would be able, if the Bill passed, to go into that district and supply customers.

The Committee adjourned.

Caledonian Electric Power Bill.

Consideration of this Bill was resumed on Wednesday and Thursday of last week.

Mr. Balfour Browne, K.C., for the promoters, continuing his opening said that the proposed area of supply extended over 1,135 square miles. That was less than the Lancashire area given last year, which covered 1,200 square miles, and a little more than the South Wales area, which was 1,086 square miles. The area had been chosen by the promoters with a view to getting the largest diversity factor they could. Of course, he did not say that every piece of the area, from Ayr on the south to Dumbarton on the north, would require electric energy, but whenever they came to a place that would require it they had taken the parish as their boundary. The promoters of the Clyde Valley scheme had refused to accept either combination or partition, which he thought was a pity. His position before the Committee was that he was willing to do either one of three things: either to amalgamate, or partition, or to proceed with his Bill in opposition to that of the Clyde Valley promoters; if the Committee thought it wise and if he could sell electricity cheaper, then he would beat them. He would like to point out that there was a fallacy about competition. He took it that the whole object was cheap production, and if they had two sets of machinery supplying one district, the production could not be so cheap as if they had only one set. Parliament now regulated these great monopoly undertakings instead of managing them by competition, and therefore, while his clients were not in favour of competition, they were quite prepared for it, because they were confident they would be able to produce energy at a cheap rate. In the area of supply there were ten undertakings authorised under Electric Lighting Acts to supply electrical energy. Those ten undertakings covered an area of 21 square miles out of 1,135 of the scheme, and their population was 366,000 out of a total of 843,000. These figures of course excluded the City of Glasgow. Hamilton and Kilmarnock had not carried out their authorised undertaking, and in their opposition were simply acting on the "dog in the manger" principle, while the system in use at Ayr, Paisley, Airdrie, and Coatbridge, was intended only for lighting purposes. The scheme he was now placing before the Committee provided for seven different generating stations—one near Yoker, one on the East bank of the Cart near Renfrew, one on the South bank of the Clyde estuary at Port Glasgow, one on the West bank of the river Leven between Renton and Dumbarton, one

on the South bank of the Clyde near Uddingston, one near Kilmarnock, and one at Irvine. It was proposed at the outset to provide for 40,000 H.P., that was 30,000 KW. They would have 25 per cent. spare plant, and the total estimated cost was provided for by £1,000,000 of share capital, with power to borrow £333,000. The promoters felt confident that with a 25 per cent. load factor they would be able to manufacture at something like ·7d. per Board of Trade unit. That, of course, was exclusive of interest on capital, but it included all other expenses. Assuming that they could sell 52,000,000 Board of Trade units yearly at 1·25d. per unit, they would have an annual income of £273,000, and after deducting the cost of production there would be a net profit of £120,000, which would be sufficient to pay 4 per cent. on the borrowed money and 7 per cent. on the share capital. The promoters were not seeking a monopoly—all they wanted was power under certain conditions to supply energy. Any of the local authorities within the district who had an order for supply would be able to come to the company and ask for so many units in bulk, and in respect to the supply of energy it was provided in the Bill that the company should not supply in the area of any authorised distributor except with the consent of the distributor, but that consent must not be unreasonably withheld. If any question should arise as to whether the consent was unreasonably withheld, the question was to be determined by the Board of Trade.

Evidence was then taken on behalf of the promoters, the first witness being Mr. A. A. CAMPBELL SWINTON, C.E., who, replying to Mr. Baggallay, K.C., said he was a consulting electrical engineer, and had had considerable experience in the transmission of electrical energy and power. During the last eight years he had been managing director and chief engineer to the Scarborough Electric Light Company and also to the company which provided electricity in Cambridge. They were both successful concerns, and worked under provisional orders. It was recognised as a matter of great importance to manufacturing districts that they should have a cheap and easily available supply of electrical power, and he considered that the establishment of electric stations capable of transmitting power at a cheap rate in the area covered by the Bill was desirable and necessary. It was as important a district as those districts in Wales and Lancashire which had already been provided for.

The CHAIRMAN: You may take it for granted that the Committee are agreed as to the importance of electricity in manufacturing districts.

Mr. SWINTON, in continuation of his evidence, said he considered that having regard to the character of the district and the diversity of purposes to which the power would be applied, the Caledonian Company would be able to supply the electricity at a very low charge. He had prepared an estimate of the amount of capital required to carry on the undertaking, and had placed it at £1,300,000. He had allowed £113,000 for contingencies and preliminary expenses, and £90,000 for working capital. They would not incur the whole of the capital expenditure immediately, and the borrowing powers would gradually come into action as the share capital was raised. Generally speaking, in framing the Bill the promoters had followed the precedent of the South Wales scheme which dealt with a somewhat similar district. There was nothing in the Bill which would give the company a monopoly or an exclusive right in any part of the district; they would have to depend entirely upon the cheapness and other advantages of their supply in order to obtain customers. They would be bound to supply electricity in bulk to local authorities if the latter wished it, but there was nothing in the Bill which would prevent a local authority from generating its own energy if it chose. They had taken the same schedule with regard to the maximum rates of charge, as that which was passed last year in the South Wales Bill. The existing supplies were, in his opinion, quite inadequate to the wants of the various districts proposed to be covered by the promoters.

In cross-examination, Mr. SWINTON said he did not think that Parliament had recognised the principle that urban districts should be excluded from the area of supply of such schemes as the present Bill sought to obtain power for. It was true that in some cases promoters had excluded urban districts with a view to conciliate the local authorities. Personally, he did not think that the provision of electric power was the proper function of a local authority.

In re-examination, the WITNESS said that the larger the generating station the better, provided that the loss in transmission was not so great as to neutralise the advantage gained by a large station.

Mr. ALEX. WYLIE, M.P., a member of the Dumbartonshire County Council, gave evidence in favour of the Bill, and said he felt satisfied that the scheme would be of great advantage to the people of the district proposed to be supplied.

Mr. J. C. CUNNINGHAME, of Merry & Cunninghame, coal and iron masters, one of the promoters of the Bill, said that the proposed area of supply contained large quantities of unexhausted coal and iron, and was a busy manufacturing district, to which a supply of cheap electric power would be of the greatest advantage. It would tend to develop all kinds of industries, and would enable electric tramways to be run.

Mr. GEORGE T. BEILBY, C.E., said that he had studied the application of electricity to various chemical manufacturing processes for some years, and there had been a great development in this country in the manufacturing of bleaching powders and caustic soda, and other chemical products. A cheap supply of electrical power was essential in that kind of work, and he saw no reason why that development should not extend to the Clyde district.

After taking the evidence of Prof. SILVANUS THOMPSON and Mr. D. J. URQUHART, of Messrs. T. Barr & Co., coal masters, one of the promoters of the scheme, the Committee adjourned.

On the Committee resuming on Tuesday, evidence was given by Lord KELVIN on behalf of the Bill. Replying to Mr. BAGGALLAY, witness said that for many years he had given attention to the question of the transmission of electricity over great distances. He was a member of the International Commission which considered the utilisation of the power from Niagara for electrical purposes. The transmission of electricity over long distances was not a difficult matter, and in America and on the Continent it was transmitted as far as 80 miles. The multiphase system was the best for transmission purposes, and there was no danger in the current being conveyed at a high voltage. As to the particular scheme before the Committee, his Lordship said he was very well acquainted with the district proposed to be served, and he believed it would be of great practical advantage to the people residing there. He had considered the positions chosen for the generating stations, and, in his opinion, they had been well chosen. They were so arranged that the maximum distance which the power would have to be sent was 15 miles. That would secure economical distribution, because the loss in transmission would be very small. He considered that the generating stations under the present Bill were better situated for their purpose than were those of the Clyde Valley Company's scheme. Of course the scale on which operations were conducted had an important bearing on the question of cost. Up to a certain point the saving increased, but beyond there was not much reduction. He believed the promoters to be thoroughly capable of carrying out the scheme if they obtained the necessary powers.

In cross-examination by Mr. Freeman on behalf of the Clyde Valley Bill, WITNESS said that his view of the matter was that the Caledonian scheme practically covered the Clyde Valley scheme, but the last-named did not cover the whole of the former. He did not wish to suggest for a moment that the promoters of the Clyde Valley scheme were not men of position and wealth, or that they were not able to carry out their scheme as successfully as were the promoters of the present Bill.

Replying to Mr. Pollock, Lord KELVIN said he advised that Glasgow should not be included in the present scheme, because Glasgow was doing this sort of thing itself on a large scale.

A large number of local and other witnesses were then called, and gave evidence in support of the scheme, which they said would be of great advantage to the district from a trade point of view.

SHANNON ELECTRIC POWER BILL.

ON Monday a Select Committee of the House of Commons met to consider this Bill, the Hon. Arthur Elliott presiding.

Mr. Bushe, K.C., with Mr. Blennerhasset, K.C., Mr. Connor, K.C., and Mr. Greig, described the nature of the proposed works, and stated that there were only two petitions against the Bill.

Mr. FRAZER, engineer to the scheme, gave evidence bearing out the opening statement of counsel as to the manner in which the promoters intended to proceed, and said he felt sure that the supply of cheap electricity would be of great advantage to the locality.

Mr. VESEY FITZGERALD, who represented the Board of Works, in reply to the CHAIRMAN, said he was instructed now not to oppose the preamble of the Bill.

The CHAIRMAN announced that the Committee found the preamble of the Bill proved.

LONDON UNITED TRAMWAYS.

THE Standing Orders Committee of the House of Commons considered an application by the London United Tramways Committee on Tuesday, asking that the consent of the London County Council should be dispensed with in regard to certain extensions in the Hammersmith district. The Committee decided not to grant the petition, but ordered the tramways in question to be struck out of the Bill.

MANCHESTER CORPORATION BILL.

VISCOUNT FALKLAND'S House of Lords Committee considered on Monday and Tuesday the Omnibus Bill of the Manchester Corporation, which sought amongst other things to make various extensions to tramways. The North-Western Railway Company, the Lancashire and Yorkshire Railway Company, and the Great Northern Railway Company, who were represented by Mr. Littler, K.C., opposed the borrowing portions of the Bill; the ground of the opposition as stated was that the railway companies would not be benefited by the proposals in the Bill, but on the contrary with regard to the tramways, would be competed against. What they asked for was the insertion of a clause to the effect that in the case of failure of the schemes, and the consequent necessity of coming upon the rates, the railway companies should be called upon to pay not more than one-fourth of the proportion of that at which under the general law they would be assessed. After considering the matter, the Committee declined to accept any such clause, and the preamble of the Bill was passed.

MANSFIELD CORPORATION BILL.

THE Omnibus Bill of the Mansfield Corporation came before a Select Committee of the House of Commons under the chairmanship of Mr. Bill on Tuesday. The Bill, amongst other things, asked for further powers with respect to gas, electricity and water. It was stated that the Corporation put up an electric lighting plant in 1899. There was no opposition to this portion of the Bill, and the preamble was passed.

CORRESPONDENCE.

Light Railways Legislation.

At the present juncture it may interest you to know what action the Tramways and Light Railways Association has taken with regard to obtaining modifications in the Light Railways Act, which is now before Parliament for renewal.

On February 28th last a deputation was received by the President of the Board of Trade from this Association, represented by our Law and Parliamentary Committee, and one or two other of our members.

This deputation laid before Mr. Gerald Balfour the following suggestions to be embodied in the new Light Railways Act, at the same time detailing their views on the various points. (See below.)

It is hardly necessary to say that the views put forward by the different speakers of the deputation had been most carefully considered beforehand, and it was felt that the amendments suggested were only fair and reasonable. It was understood that the views of the deputation should receive every attention, but it is much to be regretted that the President of the Board of Trade has not seen his way to include more of the suggestions of this Association in the new Bill.

The idea seems prevalent in some quarters that as yet sufficient experience has not been obtained to enable a permanent measure to be satisfactorily drafted, and it is therefore proposed to do little more than prolong the Act for another five years in its present form. We cannot believe, however, that the majority of those competent to judge on the question can agree with this, and before the new Bill is passed we trust that all those who are in any way interested in tramway and light railway matters will do their utmost to bring the necessity before Parliament of inserting further modifications in the new Light Railways Act than appear in the Bill as at present drafted.

Norman A. Thompson.

Secretary (Tramways and Light Railways Association).

London, W.C., *April 26th* 1901.

Suggested Points for Amendment in the Light Railways Act.

1. Applications under the Light Railways Act should not be refused a hearing on the ground that the proposed light railway lies wholly in a single urban district.
2. Make the Board of Commissioners a permanent paid body and increase their numbers.
3. The Act should not be regarded as incorporating any of the provisions of the Tramways Act, 1870, or as making any of the provisions of that Act applicable to any Order promoted thereunder.
4. The Commissioners to have power to amend the provisions of the existing Local Acts and Orders relating to any tramway undertaking to be worked in connection with the light railway, including power to postpone the date of purchase.
5. Commissioners to have power to allow land to be taken compulsorily for the purposes of constructing a road over which the light railway is to run.
6. Sec. 9, Sub-sec. (3). Add at end of Sub-section, "But shall, if so required by the promoters, submit the same to Parliament as a provisional order."
7. The Commissioners to have power in suitable cases to grant compulsory running powers subject to Sec. 23 of the Act.
8. Sec. 13, Sub-sec. (1). Omit the words "and contiguous."
9. Insert provisions enabling the Commissioners to authorise statutory companies to raise additional capital, and subscribe to Light Railway Companies and to be represented therein, and *vice versâ*.
10. Sec. 7, Sub-sec. (3). Omit the words "whether made formally or informally," and insert "made in the prescribed manner."
11. Questions of speed not to be dealt with in the Order but left to the B. of T. Inspector hereafter.
12. Commissioners to have power to vary Sec. 92 of the Lands Clauses Act, "Part of a House," and to insert "Underpinning Clause." (See Model Bill.)
13. No local inquiry to be essential to an Amending Order, and inquiries into unopposed Orders may be held in London.

Test-Room Methods of Alternate Current Measurement.

In your remarks last week on my paper on "Test-Room Methods of Alternate Current Measurement," you appear to think that I claim as novel the "thermal bridge" standard of current. I was perfectly aware that similar methods had been used, and, as Prof. Callendar was unable to be present and join in the discussion, I mentioned in particular his work in this direction. The application of the thermal bridge to alternating current measurement is not quite an easy matter, and I venture to think that my use here of a telephone as detector is new. I consider, however, that these null methods are of much less practical importance than the method I exhibited of obtaining an extremely steady current by means of a hot-wire bridge.

Albert Campbell.

Where to Construct New Electrical Works.

As is well-known, there is a remarkable tendency for trades to keep themselves to particular localities, and the reasons for this under modern conditions are not always apparent. To the electrical manufacturers or firms contemplating the putting down of new works, it would be a matter of great interest to ascertain what part of this country is really best adapted for the purpose. It has occurred to me that, perhaps, some of your readers would be able to furnish information on this point, and I venture to put before them the question "What part of the country should be chosen for entirely new electrical works, assuming that the firm putting them down had an entirely free hand, and was not influenced by any outside considerations other than the actual general adaptabilities of the locality?" I feel sure a discussion of this question would be of considerable interest to your readers generally, and I trust you will see your way to insert it in your columns.

Richard V. Lynn.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending May 1st 1900.		Week ending April 30th, 1901	
Adelaide	Value £61	Adelaide	Value £25
Alexandria	138	Antwerp	14
,, Teleg. mat.	45	Bahia. Teleg. mat.	51
Amsterdam	85	Bombay	490
Boca. Teleg. mat.	425	,, Teleg. mat.	64
Bombay	195	Buenos Ayres	42
Brisbane	128	Calais	30
Brussels	34	Cape Town	208
Buenos Ayres	75	,, Teleg mat.	2,465
,, Teleg. mat.	150	Durban	147
Calcutta	714	,, Teleg. mat.	3,650
Cape Town	1,264	East London. Teleg. mat. ..	1,300
,, Teleg. mat.	4,100	Fremantle	72
Chinde	54	Ghent	120
Colombo	51	Gibraltar. Teleg. cable ..	140
,, Teleg. cable	708	Gijon	632
Durban	234	Hamburg	166
East London	29	Hong Kong	231
Hamburg	220	Kobe. Teleg. cable	9,358
,, Teleg. mat.	500	Kure. Teleg. cable	2,624
Havre	100	Malta	25
Hong Kong	879	Ostend	500
Kobe	91	Perth	210
Malta	140	Port Elizabeth	103
Melbourne	159	Rio Janeiro. Teleg. mat. ..	244
,, Teleg. mat.	1,131	Rotterdam	21
Ostend	90	St. John, N.B. Teleg. mat. ..	34
Penang. Teleg. instruments ..	103	St. Petersburg. Teleg. mat. ..	75
Port Elizabeth	64	Santos	142
Rio Janeiro. Teleg. mat. ..	56	Shanghai	184
Rosario. Teleg. apprts. ..	198	Singapore	240
Shanghai	202	Stockholm. Teleg. wire.	170
,, 24 tons old teleg wire	—	Sydney	706
Singapore	71	Wellington	2,091
,, Teleg. mat.	541	Yokohama	782
Stettin	60		
Sydney	957		
Townsville	763		
Wellington	726		
Yokohama	318		
Total ..	£15,859	Total ..	£27,376

Foreign Goods Transhipped.

Fremantle. Teleg. mat.	Value £50	Cape Town. Elec. mat.	Value £15
Perth. Elec. mat...	303		
Total ..	£353		

Arc Lamp Carbons.—Conradty carbons for either open or enclosed arc lamps are supplied by the Sloan Electrical Company, Limited. They will be used by the Brockie-Pell Arc Lamp Company, Limited, for their arc lamps at the Glasgow Exhibition this year. They are made in various qualities, such as "C" quality, for street, factory, railway and dock lighting; "Crown" quality, for indoor lighting; "Vacuum," for enclosed arc lamps. Stocks are held by Messrs. Crompton & Co., Limited, Messrs. Johnson and Phillips, and the manufacturer's agents, the Sloan Electrical Company, Limited, 15, Fore Street Avenue, E.C.

The Automobile Exhibition.—At the Automobile Club show, which opens at the Agricultural Hall to-morrow, the 4th inst., the exhibits will include a number of electrical vehicles, the list of exhibitors in this section including Messrs. Shippey Bros., the Canadian Electrical Vehicle Company, the British and Foreign Electrical Vehicle Company, the National Motor Car Company (Joel), Mr. Carl Oppermann, and Messrs. Paris, Singer & Co. In addition there will be a number of firms showing accumulators, batteries, and other electrical accessories.

Bankruptcy Proceedings.—At Halifax on 29th ult., J. E. Bunce came up for public examination, having failed with liabilities £282, and assets £22. He stated that he started business as an electric fittings manufacturer, with a capital of between £400 and £500. Afterwards, at the suggestion of some friends, he floated the business as a limited company. He was to receive £500 in cash and £500 in shares. A cheque for £150 was handed to him, which he paid away, and instead of the remaining cash balance he accepted extra shares. The company was now in liquidation, and the shares he held were not, he was afraid, of much value. He passed his examination.

Boiler Covering.—The boilers, steam pipes, &c., at Colwyn Bay electricity works, are covered with Leroy's patent non-conducting composition.

Books Received.—"Science Abstracts" for April. London: E. & F. N. Spon, Limited. 2s. 6d.

"Quarterly Bulletin of the American Institute of Architects," October, 1900, to January, 1901. Washington: The American Institute of Architects.

"Journal of the Society of Patent Agents," Vol. 1. 1900. London: The Society of Patent Agents.

"Massachusetts Institute of Technology." Catalogue for 1900—01, and report. Boston: Rockwell & Churchill.

Browett, Lindley & Co.—Messrs. Browett, Lindley and Co., Limited, of Patricroft, near Manchester, report that they have now got their new extensions in complete working order. The new machinery for which the orders were placed when the company extended its capital has been delivered and put to work. It is interesting to note that originally the Sandon Works consisted of two main bays 176 ft. long by 88 ft. wide; one of these was used as an erecting shop, and was served by one 10-ton overhead travelling crane, the other portion being the machinery department. In the years 1895 and 1896 these shops were extended in length by 130 ft., and another 10-ton crane was provided. During last year a new main erecting bay, 384 ft. long by 48 ft. wide, with a head room of 26 ft. under the cranes, was completed. This erecting bay is served by two 20-ton overhead electrical travelling cranes, and at the end of this shop a complete testing department has been installed, complete with all electrical resistances, instruments, &c.; steam is supplied by two Climax water-tube boilers, having a capacity up to 1,500 H.P. A large tank has been erected to supply the water for the surface condenser used for taking steam consumption tests. Amongst many large orders this company has in hand we may mention:—

Eight engines, each of 1,500 H.P., of the three-crank tandem compound type, for the Salford Corporation, most of which are getting in a very forward state, the first one having been already coupled to the Mather & Platt generator on the test plate, where it will go through its official trials within the next week or two.

One 1,000-H.P. side-by-side compound self-lubricating enclosed engine, for Messrs. Sir W. G. Armstrong, Whitworth & Co., for their Openshaw Works, this being the fourth extension order to this important installation.

Three enclosed self-lubricating triple-expansion engines, of 450 H.P. each, for the Swindon Corporation.

Two engines of the triple-expansion enclosed high speed type, of 350 H.P. each, for the Accrington Corporation.

One engine of 500 H.P. for the Lowestoft Corporation.

Two engines of 750 H.P. each for the Maybank electric traction station, to the order of the British Electric Traction Company.

One engine of 600 H.P. for Messrs. Beardmore's Steel Works, Glasgow.

One engine of 850 H.P. for the Sun Paper Mill Company, Pendleton.

Nine engines, each of 500 H.P., for electric traction station in Australia.

One engine of 200 H.P. for the Colwyn Bay Extension.

One engine of 400 H.P. for Messrs. Brigley's works Bury.

One engine of 400 H.P. for the Printing Works of Messrs. Chorley and Pickersgill.

Also engines for the Barnsley Workhouse, Eccles Corporation, Messrs. Prince Smith's Works, Messrs. Jacobs' Biscuit Works, Dublin, Springfield Spinning Company, Messrs. Carter's Works, Stalybridge, Ashbury Carriage Works, Bradford Colliery, Manchester Technical School, Messrs. F. Smith, Salford, Messrs. Rodgers, of Sheffield, and many other large installations.

Although the company are so extremely busy, we may mention that as they work continuously night and day, the output has been very greatly increased, and they are thus enabled to give quick delivery of standard sizes.

Catalogues and Lists.—Mr. John Barrett, of Crosshills, *vid* Keighley, sends us a circular of the "Airedale" patent feed water heater.

G.E.C.—The General Electric Company, Limited, have been elected members of the Manchester Chamber of Commerce.

Germany.—An electrically-operated cable ropeway for the transport of coal is about to be established between the mines at Berken, and the railway station of Gäbersdorf (Silesia).

Liquidations and Dissolutions.—The Sir Hiram Maxim Electrical and Engineering Company, Limited, write us as follows:—"With reference to the recent advertisements concerning the liquidation of the Hiram S. Maxim Electrical Corporation (in liquidation) there appears to be some misunderstanding as to the reason therefor, and we may inform you that the business of this company has been sold on favourable terms to the Sir Hiram Maxim Electrical and Engineering Company, Limited. The liquidation proceedings were purely voluntary, and were instituted only for the purpose of carrying out this sale. The whole of the old company's creditors are being paid in full, and the shareholders will receive for their present holding shares in the Sir Hiram Maxim Electrical and Engineering Company, Limited."

Lironi v. Moon, Loughlin & Co.—At the Manchester Assizes, Mr. Victor Lironi, an electrical engineer, claimed damages from Messrs. Moon, Loughlin & Co., manufacturers of electrical fittings, Market Street, Manchester, for breach of agreement and arrears of salary. Before the case for the plaintiff had been concluded, counsel on his behalf agreed to judgment for the defendants on the claim and counterclaim.

Organ Blowing by Electric Motors.—Referring to the note in our issue of the 19th ult. on the organ in Lincoln Cathedral, Messrs. Bergtheil & Young inform us that the whole of the blowing apparatus for the Cathedral was arranged for and designed by the firm, under Mr. Arthur Bergtheil's personal supervision, while the contract and all responsibility in connection therewith was placed with them, and has remained with them ever since.

Trade Announcements.—Messrs. De Grelle, Houdret and Co., electrical and mechanical engineers, of 130, London Wall, E.C., have been appointed sole representatives in Great Britain for the Braunschweigische Maschinenbau-Anstalt for the sale of their dynamos, motors, and other electrical manufactures. We have received a copy of their latest illustrated price lists. Messrs. De Grelle will keep a stock of their open and enclosed type machines in London ready for immediate delivery, and most of the other sizes listed may be had in three or four weeks.

Messrs. Charles Marco & Co. have taken an additional floor at 4, New Zealand Avenue, Barbican, E.C., and fitted it up as showrooms for the display of their specialities.

The Bullock Electric Manufacturing Company has acquired control of 15 acres of land directly opposite the present plant at East Norwood, Ohio, upon which the Norwood Foundry Company will erect a foundry and a pattern storage house. The plant will be of the most modern character, and electricity will be used for power and lighting throughout. While this foundry will be operated under the name of the Norwood Foundry Company, it will serve primarily the needs of the Bullock Company.

The Berrenberg Electric Lamp Syndicate, Limited, have registered the trade mark "Minim," and in future will stamp their lamps with this word, "Minim," instead of "Berrenberg."

ELECTRIC LIGHT AND POWER NOTES.

Barnes.—The Barnes and Mortlake electric light works were formally opened last Wednesday. The building has been erected by Messrs. Munday & Sons, of Tower Hill, from designs by Mr. Fairley, consulting engineer to the Barnes District Council, and is admirably adapted for the purposes in view. The amount originally borrowed by the Council was £31,000. Fourteen miles of mains have already been laid. There are four high-speed enclosed triple expansion engines, directly coupled to Siemens dynamos, two of 200 KW. and two of 40 KW. capacity. The switchboard was also built by Messrs. Siemens Bros. The boiler house contains three Babcock & Wilcox boilers, with space for another condensing plant and two feed pumps. The water is taken from the river, and coal is unloaded from barges in the river practically direct into the boiler house. The resident engineer appointed by the Council is Mr. Davidson.

Barnsley.—A L.G.B. inquiry was held on Friday last into the application of the Corporation for sanction to borrow £20,000 for extension of electric lighting works. The installation was opened about a year ago, the capital outlay being £25,000. Temporary plant, costing £3,500, was added, but the growth of the demand renders large extensions urgently necessary.

Bath.—At the monthly meeting of the E.L. Committee last week, the clerk read the auditor's statement for 15 months ended March 25th last. There was a gross profit of £3,988, but as interest on loans amounting to £2,577 and £2,404 sinking fund had to be paid, £993 had to be provided from the rates.

Birkenhead.—During the year ended March 31st, the Corporation supplied electrical energy to the quantity of 289,024 units, to 273 consumers. Compared with the previous 12 months, this is an increase of 21 per cent. in consumption, and 27 per cent. in the number of consumers.

Dublin.—At the fortnightly meeting of the Lighting Committee last week a letter was received from the L.G.B., announcing that it had decided to remit the surcharges of £2,085 made against members of the Committee last year by the auditor on account of the expenditure in re-wiring customers' premises; the Board considered that the auditor's action was lawful, but that as the Corporation believed they had legal power to incur the expenditure it was fair and equitable that the surcharges should be remitted.

Exeter.—The electric lighting accounts for the past year were less favourable than in previous years, owing principally to the high price paid for coal, and to the circumstances that, in view

of the approaching removal to a new station, many items ordinarily chargeable to capital have been paid out of the current revenue account. The coal expenditure was £770 more than in 1899. The receipts showed an increase of 10 per cent. on 1899, despite the fact that no addition was made to the charge for current. The general result was a surplus on the year's working of £2,322, leaving after payment of interest and sinking fund charges, a net surplus of £377. The accumulated net surplus since the Council acquired the undertaking now exceeds £2,700.

Kingston-on-Thames.—The L.G.B. has sanctioned a further loan of £17,800 for extensions at the Corporation electric lighting works. The receipts for current during the quarter ending March 31st were £1,880, an increase of £100 on the previous year.

London.—L.C.C.—The Council at the meeting on Tuesday resolved to advance £10,600 to the Battersea Borough Council for extending the electric lighting mains.

The report of the Highways Committee reminded the Council of the conference which took place in June, 1898, of members of the Committee and representatives of the City Corporation and of the then existing Vestries and district boards, to consider proposals contained in Bills before Parliament at that time for the establishment of undertakings for the supply of electricity in bulk. Since then Parliament had, in four cases, authorised the establishment of bulk supply undertakings. It appeared to the Highways Committee that all arrangements for bulk supply seriously reduced the powers of purchase given to local authorities, as they rendered it difficult for a local authority to acquire the whole undertaking within its district as a going concern. In December, 1899, the Council, in order to give effect to the views of the conference, submitted to the Board of Trade for consideration a draft clause framed to authorise purchase by the Council in cases where it is not the local authority; but in January, 1900, the Board stated that, in view of the nature of the proposals in the clause submitted by the Council, the matter became one upon which, in the opinion of the Board, the local authorities concerned should have the fullest opportunity of expressing their views, and that, having regard to the important changes of London administration which were to be made under the provisions of the London Government Act, 1899, it appeared to be inexpedient that the question should be pursued at that time. Since then the Committee had approached the Borough Councils, asking for an expression of opinion with regard to the resolutions passed at the conference, and as to the advisability of another meeting being held to consider the subject. The replies showed that 13 of the Councils were in favour of a fresh conference. Having regard to the importance of the matter, the Committee considered it desirable that a further conference should be held on May 16th. The Council decided to authorise the Committee to invite the City Corporation, the Westminster City Council, and the Borough Councils to appoint representatives to confer with the Committee in regard to the subject.

It was decided to accept an offer made by the Poplar Borough Council to supply current for the lighting of Greenwich Tunnel at 1·8d. per unit, upon an estimated minimum quantity of 100,000 units per annum.

An intimation had been received from the B. of T. announcing that it would not proceed with the application of the North Metropolitan Electrical Power Distribution Company for a prov. order in respect of Stoke Newington.

Approval was given to plans submitted by the Shoreditch Borough Council for the erection of a generating station in Bath Place, Haggerston.

The *Times* says that a meeting of members of Parliament, and also of representatives of both large and small consumers of electric light throughout London, is to be held to discuss the best means of protecting the public interests affected and safeguarding the capital employed in supplying electricity in the metropolis.

Middleton.—On Thursday last Colonel Luard, R.E., held a L.G.B. inquiry into the application of the T.C. for leave to borrow a further sum of £12,442 for electric lighting purposes. In July of last year the Board sanctioned the borrowing of £21,592 for similar purposes. Since that time the Corporation has entered into a contract with the British Electric Traction Company to supply them with the current to work their light railways in the neighbourhood. The company had guaranteed a minimum consumption of 300,000 units per annum. The commencing price up to 300,000 units was 1·5d. per unit. For the next 100,000 it would be 1·4d. per unit, for the next 100,000 1·3d. per unit, and so on up to 700,000 units, when the price would be 1d. per unit. In consequence of that agreement it had been necessary to extend the plant.

New Zealand.—A New Zealand paper says that Mr. Stewart, of Stewart & Fenn, electrical engineers, of Auckland, has returned from a visit to Te Renga Waterfalls, 30 miles from Gisborne. He considers there are no engineering difficulties in the way of harnessing it, and that there would be an abundant supply for Gisborne, which would be able to compete for all practical purposes with any motor power at present in use.

Newport.—At a special meeting of the Borough Council called on Tuesday to consider tenders for part of the new electricity works, amounting to £55,000, the question was deferred by a majority of one after a warm discussion. A proposal to call in Prof. Kennedy, adviser to the Manchester Corporation, to report as to the situation, was lost, and it was determined to ask Mr. Parshall to report as to the utilisation of the present station for the additional energy.

St. Helens.—On Friday last week the T.C. inspected the electric power station at Cropper's Hill, on the invitation of the Mayor and the chairman of the Electric Supply Committee. The works have been extended by the addition of a 600-H.P. steam dynamo. During the year, the demand for electricity for lighting purposes has doubled, whilst for traction purposes the demand has been trebled.

Spain.—A company has lately been formed in Spain with the title La Sociedad Electrica Industrial Sagnena, to acquire and work a water power driven central station on the River Tajo, and to supply current for lighting and power purposes to Villaseca de la Sagra and district.

West Bromwich.—The L.G.B. has sanctioned the borrowing of £9,750 for providing materials for wiring houses and supplying motors for hire. The period for repayment is 10 years. The Board declined to sanction an item of £250 for providing lamps, which it considered should be paid out of revenue.

West Ham.—An interesting report has been presented to the Council by the borough electrical engineer, Mr. J. K. Bock, on the electric lighting of artisans' dwellings. Our readers will remember that the electric light was installed in the artisans' dwellings built by the Corporation in Bethell Avenue last year, and charged for at the rate of 6d. per week per tenement. At that time there were no data on which to found a close estimate of the cost of the supply; but a meter and demand indicator were fixed in each block to ascertain the actual consumption. The results are shown in the following tables, and are of considerable interest:—

Quarter ending Sept., 1900.	Block 1. 20 tenements (14 weeks).	Block 2. 16 tenements (14 weeks).	Block 3. 18 tenements (11 weeks).
Units registered by meter ..	150 at 7d. 200 at 2d.	137 at 7d. 348 at 2d.	150 at 7d. 232 at 2d.
Price by meter	£8 10s. 10d.	£6 17s. 11d.	£6 6s. 2d.
Average price per tenement per week by meter.	7¼d.	7½d.	7½d.
Average price obtained ..	6d.	6d.	6d.

Total average price per tenement per week by meter .. .. 7½d.
Total average price per tenement per week obtained .. .. 6d.

Quarter ending Jan. 4th, 1901.	Block 1. 20 tenements (14 weeks).	Block 2. 16 tenements (14 weeks).	Block 3. 18 tenements (18 weeks).
Units registered by meter ..	192 at 7d. 1,404 at 2d.	160 at 7d. 1,186 at 2d.	246 at 7d. 1,259 at 2d.
Price by meter..	£17 6s.	£14 11s.	£17 3s. 4d.
Average price per tenement per week by meter.	1s. 2¾d.	1s. 3¼d.	1s. 1d.
Average price obtained ..	6d.	6d.	6d.

Average price per tenement per week for the half-year if sold by meter	11d.
Deduct 1½d. for repayment of meters	1½d.
	9½d.
Average price per tenement per week received for the half-year	6d.
Deduct cost of lamp renewals, &c.	1½d.
	4½d.

It will be seen from the above figures that in order to place the artisans' dwellings on the same basis as ordinary consumers, it is necessary either to increase the charge per week, to instal ordinary meters and demand indicators, or to instal prepayment or penny-in-the-slot meters. The present charges for electricity are 7d. per unit for an average of one hour per day, and 2d. per unit for all units over this quantity; accordingly, if the light is used for an average of one hour per day the average cost will be 7d. per unit; if two hours, 4½d. Mr. Bock concludes by suggesting that prepayment meters be installed in all the artisans' dwellings, and in any other private dwelling if the installation does not exceed three amperes, and that the charge be 4½d. per unit. Pre-payment meters should only be installed at this rate in private dwellings, as shops, &c., being shorter-hour consumers, the conditions are changed. By doing this all dwelling houses are offered the same terms as the artisans' dwellings.

Woking.—At a meeting of the U.D.C. an attempt was made to retain the electric street lighting, but it was unsuccessful, the motion for the rescission of the Council's resolution accepting the gas company's tender being defeated by 9 votes to 7.

ELECTRIC TRACTION NOTES.

Calcutta.—The Government of Bengal has granted to Messrs. Kilburn & Co., of Calcutta, acting on behalf of the Calcutta Electric Supply Corporation, Limited, a license to supply electricity in the "additional added area" of Calcutta, as specified in the license.

Altrincham—Stretford. — The Barton (Manchester) Rural District Council has endorsed the decision of the Flixton Parish Council, not to entertain the proposal to run electric cars through Flixton in conjunction with a scheme to run cars from Altrincham to Stretford, and thence through Flixton and Davyhulme.

Bishop Auckland.—A scheme for the laying down of some 20 miles of electrical tramways, estimated to cost between £100,000 and £150,000, in the Bishop Auckland district of Durham is to be the subject of consideration at a conference of the local authorities within the next few days.

Crompton.—The Board of Trade has sanctioned the proposed tramway scheme, and it will shortly go before the House of Commons for approval. The Bill of the above authority empowering electric lighting for the district has passed the first reading of the House of Lords.

France.—Application has been made by the Dunkirk Tramways Company for authority to convert the horse tramways in the Port of Dunkirk into electric lines on the overhead conductor system.

Grimsby.—The Grimsby Tramway Company have made considerable progress with the arrangements for running their cars by electricity. During the past week or two the standards have been erected, and it is hoped by Whitsuntide to have the cars in full working order.

Kingston-on-Thames.—At the meeting of the T.C. on Tuesday, it was finally decided to accept the heads of agreement with the London United Tramways, Limited, and to consent to the promotion of the Company's Bill, subject to a right to oppose on clauses.

Liverpool.—Through fire occurring at a section box near the end of Stanley Road, Liverpool, one day last week, the electrical connections were severed and a stoppage of the electric car traffic in the vicinity was caused. The damage was repaired during the night. Two telephone wires which were suspended over Lime Street, Liverpool, fell on Thursday of last week. One of them came into contact with the live trolley wire of the car system, and caused some excitement in the neighbourhood. The wire was removed without any personal injury being caused.

A model of the George Sleeman life-saving fender for electric cars has been on view in Liverpool for some days. The invention is of Canadian origin, and has been exhibited in Liverpool by Mr. R. A. McGuinness, the agent for the United Kingdom for the fender.

The Manhattan and Central London Railways.—The British Thomson-Houston Company, Limited, have received information from their allied company, the General Electric Company, of New York, that the latter have secured, after severe competition, the contract for the train equipments of the Manhattan Railway (New York Elevated), including 1,600 large motors of over 100 H.P. each. The trains are to be equipped with their train system of control, which is the same as the B.T.H. Company are supplying to the Central London Railway for their experimental train. We are informed that this is the largest contract for car equipments that has ever been placed.

The Metropolitan District Railway.—According to the *Times*, notification is given by the Metropolitan District Railway Company of an intended application this session, by petition, for additional provision for leave to introduce into the Bill which has been presented to Parliament clauses or amendments to confirm an agreement for the electrification and equipment of their railways, the City lines and extensions of the company and the Metropolitan Company, the Whitechapel and Bow Railway, and portions of the London and South-Western Railway; to mortgage, lease or transfer the lands they are authorised to use as a generating station in Lot's Road, Chelsea; and to empower them to take a lease of these lands from the transferee or lessee thereof. With the consent of the South-Western Company, they will ask to be empowered to lay and maintain along so much of the former's railway as lies between Studland Road junction and the junction of the South-Western Railway with the company's Ealing Extension Railway five chains westward of Turnham Green Station, this station and Richmond Station, and the termination of the company's Fulham Extension Railway five chains southward of Putney Bridge Station and the Wimbledon Station of the South-Western Company, cables, conducting rails, &c., and to execute all works necessary for adapting such railways to being worked by electrical power and for transmitting along them electrical energy from the company's generating station. Authority will also be asked to constitute the generating station which the company are empowered to construct at Lot's Road into a separate undertaking. By other clauses the company will ask to be empowered from time to time to issue and dispose of their unissued authorised capital and any capital sanctioned by the Bill at a discount, and to create and issue the debenture stock for the money which they are empowered to borrow by Sec. 76 of their Act of 1897, notwithstanding that the ordinary stock in respect of which it is authorised to be borrowed is issued at a discount. Power will also be asked to alter and prescribe the dates to and at which the dividends on the company's shares and stocks are calculated. Messrs. Baxter & Co., Victoria Street, Westminster, are solicitors for the Bill, and the Parliamentary agents are Messrs. Martin and Leslie, Abingdon Street, Westminster.

Middlesex.—The Middlesex County Council is applying for light railway powers to construct electric tramways from Tottenham, through Wood Green and Friern Barnet, to a point near Colney Hatch Asylum, and from Highgate Archway, the London boundary, along Archway Road and Great North Road, to the Hertfordshire boundary, near Whetstone. The total cost will exceed half a million.

New York.—Our New York namesake says that the Metropolitan Street Railway Company, of New York city, will soon change over its existing cable lines to electricity, thus making all the main line traffic of its great system in Manhattan electrical. Other important changes in the system will also be made so that certain ferries on the West Side may be more easily accessible.

Pontypridd.—The B. of T. has sanctioned the D.C.'s scheme for an electric tramway.

St. Helens.—Mr. Highfield, electrical engineer of St. Helens, reported at the meeting of the Health Committee that the amount of refuse burnt in the destructor last year had been 9,778 tons. The average cost had been £1 5s. 1d. per ton. Steam was, however, supplied by the destructor for the electrical department, and the number of units sold by the department had been 329,716, which reduced the cost of burning the refuse to £1 1s. 8d. per ton. In addition to this the destructors supplied power for the mortar mills and winch. The weight of coal saved had been 687 tons per annum.

Last week Mr. J. F. Cuttler, manager of the St. Helens and District Tramways, conducted a series of experiments at the car sheds, with a view to preventing accidents through falls of wires on electric trolley wires. Mr. Cuttler insulated the trolley wires at points where other wires passed over them by using india-rubber cloth fixed by means of a solution. He believes that an india-rubber insulation would be more effective than the ordinary wooden protector. The experiments were considered to be successful.

Spen Valley.—The Board of Trade have approved the following:—Spen Valley Light Railway Order, 1901; Spen Valley Light Railway (Extensions) Order, 1901.

Wolverhampton.—A special meeting of the T.C. was held on Monday for the purpose of considering a proposal by the Tramways Committee to adopt the "Lorain" system of traction on the new tramways. At first the Committee were in favour of overhead traction; afterwards they visited Paris to witness the "Slatter" system in operation, and since then they have had interviews with the agent of the Lorain Steel Company, of America, by whom this system of traction is being put forward in this country. The Lorain system consists outwardly of an oblong stone or granite trough, about 20 in. by 14 in., in the bottom of which is a circular plate carrying an attachment to the electric cable, which runs beneath. Immediately above this plate is placed a vulcanite hollow cylindrical box divided in halves, each containing a round carbon stud about the size of a crown piece, that in the lower half being attached to a hinged copper piece. The upper and lower half of the cylinder are so closely fitted together, and clamped with metal rings outside, as to be perfectly air-tight. This, again, is covered by an oblong block of metal, the two end portions formed of cast-iron, and the centre of Harveyised steel. The apparatus thus complete is let into the roadway at distances of about 15 or 20 ft. apart. Attached to the under surface of each end of the car, in a twin pair of upright drums, are powerful magnets, and running along immediately behind them is a skate. As the two magnets pass over the steel plate in the granite trough before mentioned, they cause the carbon stud in the lower half of the cylinder beneath to rise up in contact with that in the upper half. The skate at the same moment completes the contact, the rear portion of the car passing over one stud as the front portion covers the next. The total cost of adopting the Lorain system would be in Wolverhampton about £28,000 more than if the overhead system were carried out; or £2,000 extra per annum.

At the Council meeting on Monday the Town Clerk read a letter from the Lorain Steel Company, stating the conditions under which they were prepared to lay an experimental line from Tettenhall to the borough boundary. The line would be laid in about eight to 10 months, and the company would deliver three motor car equipments within about three months of receiving the consent of the Council, a condition being that the Council should give the cars a thorough test under actual working conditions for at least 60 days. If the experimental test was a success the Corporation and the company to agree to enter into a contract for laying 10 miles of single track. If the experiment did not prove to be a success at the end of a year the company would take up and reinstate the track without charging the Corporation anything. The company also agreed to put down a mile of track on the Bilston Road, and have it in working order in about three months, if the Corporation wished it. The Council adjourned until Monday next, when the question will be further discussed.

On the invitation of the inventor and patentee of the Kingsland surface contact system of electric traction—Mr. W. Kingsland, M.I.E.E.—members of the Wolverhampton Corporation Tramway Committee, with other representatives of the public, on Monday inspected it, and saw a tramcar in motion. Mr. Kingsland has been working at the surface contact system for several years, and has devised an ingenious method of operating the switches; he claims to have eliminated all the dangers urged against the surface contact systems hitherto known. The leading feature of the system under notice, is that the current is switched on and off by mechanical means. We shall shortly be in a position to give full particulars o the system.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communications Committee.—A meeting of the Committee was held on Tuesday at St. Stephen's House. Evidence was given by Mr. J. C. Lamb, C.B., C.M.G., second secretary to the General Post Office.

Cape—Australia Cable.—A *Times* telegram from Adelaide says that the work of laying the new cable to the Cape has been begun.

Liverpool Telephones.—Councillor Kebby Fletcher gave notice of motion in the following terms for Wednesday's City Council meeting:—"That in the opinion of this Council, it is advisable to establish a municipal system of public telephone communications, and that the Finance Committee be instructed to obtain a licence from the Postmaster-General."

London Post Office Telephone System.—In the House of Commons on 25th ult., in answer to Mr. Bartley, Mr. Austen Chamberlain said: "It is hoped that it will be possible to connect the premises of subscribers with some of the principal exchanges in about five or six months' time, if no further delay occurs owing to the difficulty of carrying out structural alterations in buildings in which other Post Office work is being carried on."

Postmaster-General and Underground Telegraphs.—The Postmaster-General, in reply to a communication addressed to him upon a resolution on the subject of underground telegraphs, passed at the Paris meeting of the Associated Chambers of Commerce of the United Kingdom, writes saying that the question of the inconvenience caused by any dislocation of the telegraphic service has engaged the serious attention of the Government for many years. It was very unusual for departmental notices of delay to be in force for more than one or two days through storms, and it seldom happened that any town was completely cut off from telegraphic communication. In the North of England towns, for example, during the past six years the average number per year of notices of delay had been only six, and the average duration of the notice 1 hour 23 minutes. Last year seemed to have been singularly unfortunate. Much had already been done to provide against interruptions. The principal lines had been renewed with much stouter timber. A large number of reserve wires had been provided, and these had as far as practicable been taken by alternative routes. Respecting the provision of underground lines, the great costliness of gutta-percha-covered wire and its electrical defects had until recently stood in the way of its being used except in limited extent. The introduction of the paper insulated cable, both cheaper and better from an electrical point of view, had, however, enabled the Department to construct the important experimental underground line between London and Birmingham. The line had already proved of great advantage during last year's storms. It was subject to some drawbacks, but he (the Postmaster) felt justified in extending it further northward, and sanction for the necessary expenditure would be sought. He hoped also to lay an underground section from Preston northwards, and was not without hope that further extensions might be made.

Projected New Cables.—The *Daily Chronicle* Brussels correspondent says it is understood that Holland and Germany have decided to construct a system of cables in the East that will render them independent of the cables of the English Government. The principal line will terminate at Shanghai, from which three branches will run to Kiao Chao in the north, Japan and America and the Pacific islands. The southern cable will first reach the Bismarck Archipelago without touching any English possession, and after making a long circuit will join the Dutch cable running to the islands situated to the north-west of Borneo.

Protest against Laying Manila Cable Overruled.—The New York *Electrical Review* says that the Eastern Extension Company, which controls the cable running from Hong Kong, China, to Manila, P.I., some time ago protested against the laying of United States cables in the Philippine Islands to connect with Manila, as under the Spanish *régime* the privilege was granted to the company of exclusive rights in cable construction. The permission was accompanied by but one reservation, which stated that the Spanish Government had the right to lay cables for State purposes. The United States cable-ship *Burnside* is to continue laying cables for the War Department, the United States Courts having decided that the cable in process of construction is for State purposes, and that the Spanish concession is not violated thereby. The grant made to the cable company was put into effect immediately prior to the Spanish-American War, and extends over a period of 40 years.

Swedish Telephones.—Work is in hand on the erection of a telephone line between Lulla, the great iron-ore shipping port and Stockholm.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Taku-Chefao	.. March 29, 1901 ..	..
Singaradja-Macassar	.. April 14 ..	.. April 30
Latakia-Cyprus	.. June 20, 1899 ..	..
Para-Maranham	.. March 1, 1900 ..	..
Cayenne-Pinheiro	.. April 20, 1901 ..	..
Landlines:—		
Chinese:—Pekin-Kalgan	.. June 14, 1900 ..	..
Tientsin, *via* Shanghai	.. June 16, 1900 ..	..
Kalgan-Maimatchin	.. June 30, 1900 ..	..

Wireless Telegraphy.—The Marconi system of wireless telegraphy has for some time been tested in the districts between Wady Halfa and Khartum, in the Sudan, most satisfactorily. The tests are, according to the *Daily Mail*, now being conducted south of Khartum. As Lord Cromer indicated in his recent report, there is every reason to believe that wireless telegraphy will be used to keep up communications between Uganda and the furthest point south of Khartum to which the telegraph is now laid. It is also probable that the Nile steamers will be fitted with the Marconi installation.

It is stated that the "Cunard Steamship Company are contemplating the adoption of Marconi's wireless telegraphic system for signalling at sea. A trial will shortly be made on the voyage between Liverpool and New York, when one of the instruments will be placed on board the *Lucania* or *Campania* to work in conjunction with instruments fixed at stations *en route*."

The Postmaster-General on 26th ult. received a deputation introduced by Mr. Henniker-Heaton, to urge the national importance of the Marconi system of wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

OPEN

Bermondsey.—May 21st. The Borough Council wants tenders for the wiring, fittings, &c., for the installation at the electricity works and stables. See "Official Notices" to-day.

Bradford.—The Bradford Corporation are about to advertise for material for the overhead equipment of the Manchester Road Tramway. They have decided to use Cooper's patent joint rails throughout this route.

Bristol.—May 9th. The Electrical Committee wants tenders for steam and other piping, low tension switchboard, and 210-kw. C.C. dynamo. See "Official Notices" April 26th.

Bristol.—May 12th. The Electrical Committee wants tenders for alternating current transformers. See "Official Notices" to-day.

Christiania.—May 9th. The Secretary of State for Foreign Affairs has received a dispatch from H.M. Consul-General at Christiania, stating that tenders are invited by the Telegraph Department of the Norwegian Government, to be received not later than May 9th, for the supply of copper wire, copper ribbon wire, and tinned soldering wire. Specifications and drawings may be seen daily between 12 and 1 p.m. at the Rigstelegrafstyrelsens Kontor, Christiania.

Copenhagen.—May 4th. The Corporation wants tenders for the supply of a network for a new central station. See "Official Notices" April 12th.

Dundee.—May 11th. The Gas Commissioners want tenders for a 700-h.p. triple expansion steam engine and dynamo. See "Official Notices" April 26th.

Dublin.—June 3rd. The Lighting Committee wants tenders for main and sub-station switchboards, transformers, arc lamps and pillars. See "Official Notices" April 26th.

Edinburgh.—May 6th. The Council wants tenders for electricity meters. See "Official Notices" April 26th.

Fulham.—May 15th. The Council wants tenders for materials for the electric light and dust destructor works. See "Official Notices" April 26th.

Great Eastern Railway.—May 14th. The directors want tenders for the supply of stores and materials. There are 23 different sections, including one for telegraph materials. See "Official Notices" April 19th.

Hendon.—June 5th. The U.D.C. wants tenders for the wiring of the new Council offices. See "Official Notices" to-day.

Long Eaton.—May 20th. The Council wants tenders for two Lancashire boilers, engines, dynamos, switchboard, &c. See "Official Notices" to-day.

Manchester.—May 7th. The Tramways Committee wants tenders for the supply of cast-iron curbs for tramway centre poles. See "Official Notices" to-day.

Manchester.—May 7th. The Electricity Committee wants tenders for water-tube boilers; plant of 15,000 i.h.p. in generating and sub-stations, comprising steam engines, &c., three-phase generators and motor transformers. See "Official Notices" April 12th.

Motherwell.—May 18th. The E.L. Committee wants tenders for cast-iron lamp columns, arc lamps, switches, fittings, &c.

Newport (Mon.).—May 8th. The Guardians want tenders for completing the electric light installation at their new workhouse. See "Official Notices" April 26th.

Norwich.—May 7th. The Norwich Mutual Telephone Company, Limited, is about to establish a telephone exchange, and invites tenders for cables, wires, pipes, ironwork, poles, insulators, batteries, telephones and other instruments, switchboards, &c., required in connection therewith. See "Official Notices" April 12th.

Plymouth.—May 18th. The Corporation wants tenders for overhead line construction. See "Official Notices" to-day.

Rochdale.—May 16th. The Corporation wants tenders for two 412-KW. steam dynamos. See "Official Notices" April 26th.

South Lancashire.—May 13th. The S. L. Electric Traction and Power Company wants tenders for 6,250 tons of steel tram rails, 190 tons of fish-plates, also points, crossings and filling pieces. See "Official Notices" April 26th.

Stirling.—Latest date for sending in tenders for steam pipes, &c., has been extended from May 1st to May 10th.

Swansea.—May 3rd. Tenders are invited for the electric wiring and fitting of the courts and offices at the Guildhall.

Swansea.—May 15th. The Corporation wants tenders for two-phase motor alternators and switch gear. See "Official Notices" April 26th.

Tonbridge.—May 30th. The U.D.C. wants tenders for Lancashire boilers, two 50-KW. steam dynamos, condensing plant, crane, switchboard, battery, mains, arc and incandescent lighting, house meters, &c. See "Official Notices" April 12th.

CLOSED.

Bolton.—The Electricity Committee has ordered engines for the electricity works extensions from Messrs. Musgrave.

Bray.—La Société Anonyme des Moteurs à Grande Vitesse, represented in this country by Mr. J. Pullar Phibbs, of Wool Exchange, E.C., has secured the order for a 25-KW. alternator for the Bray municipality.

Cheltenham.—Messrs. Geoffroy and Delore (London house, Mr. J. Pullar Phibbs), have obtained the order for the whole of the underground cable required for the Cheltenham light railway at present under construction. This cable is of their fibrous insulation type, lead-covered and armoured, and the length of it is about 5½ miles.

France.—The French Post and Telegraph authorities in Paris have just placed the following contracts with La Compagnie Française des Métaux, Paris: 30 tons of bronze wire 15/10 mm. diameter, at 255 fr. per ton; 40 tons of copper wire 3 mm. diameter, at 205 fr. per ton; 40 tons ditto, at 204 fr.; 40 tons ditto, at 203 fr.; 40 tons ditto, 5 mm. diameter, at 203 fr.; 40 tons ditto, at 202 fr.; and 40 tons ditto, at 201 fr.

Kingston-on-Thames. — The T.C. has accepted the tender of Messrs. F. & E. Davey, at £1,989, for the erection of a new chimney shaft at the electricity works; that of Messrs. Babcock and Wilcox, at £4,160, for new machinery, condenser, pipes, &c.; and that of Messrs. Scarfe & Sons, of Stalybridge, at £635 for an economiser.

Newport (Mon.).—The following tenders have been recommended by the Electricity and Tramways Committee for the Corporation tramways and power station: — (1) Foundations, A. S. Morgan & Co., Newport, £9,349 10s. 4d.; (4) structural steelwork, Hemmingways, Limited, Middlesbrough, £11,955; (5) steel flue, J. Lysaght & Co., Bristol, £712; (6) coal and ash conveyor, The New Conveyor Company, Birmingham, £1,987; overhead traveller, J. Hitchin and Son, Halifax, £955; (9) steam boilers, Babcock & Wilcox, Limited, London, £5,893; (10) mechanical stokers, Underfeed Stoker Company, London, £1,198; (11) fuel economiser, A. Lowcock, Limited, Shrewsbury, £575; (12) water storage tanks, Westwood and Wright, Brierley Hill, £324; (13) steam engines, Markham and Co., Chesterfield, £11,590; (14) electric generators, Witting Bros. for Kolben & Co., Prague, £5,170; (15) condensing plant, Worthington Pumping Engine Company, London, £5,056; (16) feed water pumps, J. P. Hall & Sons, Limited, Peterborough, £292. Total, £55,056 10s. 4d.

Northumberland.—Messrs. William Arnott & Co. have secured the contract for two high pressure Lancashire boilers for the Northumberland County Council in connection with their electric scheme.

Nottingham.—The Notts Standing Joint Committee has accepted the tender of Mr. W. J. Furse, electrician, of West Bridford, to instal the electric light throughout the Shire Hall, at Nottingham.

FORTHCOMING EVENTS.

Friday, May 3rd.—Society of Arts. Howard Lecture, by A. C. Eborall, on "Polyphase Electric Working." Lecture II.—The parallel running of polyphase generators—The testing of large generators—Polyphase transformers; standard constructions and arrangements—Efficiency and drop; pre-determination of the latter on non-inductive and inductive loads—The heating of large transformers—Synchronous polyphase motors.

At 8 p.m. Institution of Junior Engineers. Meeting at Westminster Palace Hotel. The Northcott Prize Paper, on "How may the best efforts of Employers and Employed be exerted for their Mutual Advantage, and for the National Benefit?" by Mr. William Powrie.

Saturday, May 4th.—Institution of Electrical Engineers (Students' Section). Visit to the Davies Street works of the Westminster Electric Supply Corporation.

Monday, May 6th.—At 8 p.m. Society of Arts. Cantor Lecture, by Sir W. C. Roberts-Austen and T. Kirke Rose, on "Alloys." (Lecture III., to be delivered by Dr. Rose.)

Tuesday, May 7th.—At 7.30 p.m. Institution of Electrical Engineers. Students' Meeting at the Finsbury Technical College, Leonard Street, E.C. Paper on "Recent Work on Hertz Wave Phenomena and their Application to Wireless Telegraphy," by F. I Hiss, jun.

Thursday, May 9th.—At 8 p.m. Institution of Electrical Engineers. Ordinary general meeting at the Society of Arts—*not* at the Institution of Civil Engineers. Paper on "Storage Batteries in Electric Power Stations, Controlled by Reversible Boosters," by J. S. Highfield.

Friday, May 10th.—At 9 p.m. Royal Institution meeting. Paper on "The Response of Inorganic Matter to Mechanical and Electrical Stimulus" by Prof. J. C. Rose.

Society of Arts. Howard Lecture, by A. C. Eborall, on "Polyphase Electric Working." Lecture III.—Polyphase induction motors: standard constructions and features of design—The construction, application, and limitations of the Heyland diagram for polyphase induction motors—Examples taken from practice.

NOTES.

Liverpool Salaries.—At the meeting of the Liverpool City Council last week, proposals were made on behalf of the Council to increase the salaries of several officials. When moving an amendment to the proposal that the deputy town clerk's salary be increased from £900 to £1,000, Councillor Thomas Utley remarked that he did not think the Electric Lighting Committee would show a profit which could go to the relief of the rates, and as to the Tramways Committee they had enormous responsibilities in connection with accidents. The insurance company had thrown up their contract, and 1,800 claims had been handed over to the Corporation to settle. The salary of Mr. John A. Brodie, city engineer, was increased from £1,000 per annum to £1,400. That of Mr. Joseph Parry, water engineer, was increased from £1,200 to £1,400. In the tramways department the following increases in salaries were made:—Mr. Charles Revill Bellamy, general manager, from £1,000 to £1,200. Mr. P. McCullough, assistant manager, from £500 to £550, increasing by annual increments of £25 to £600 per annum; he to take up the duties of electrical equipment engineer. Mr. C. W. Mallins, traffic superintendent, from £300 to £350 per annum, increasing by annual increments of £25 to £400 per annum. Mr. Thomas Bulmer, chief book-keeper in the controller's department, from £300 to £325, increasing in 12 months to £350 per annum. In the electric supply department, the salary of Mr. A. Bromley Holmes, city electrical engineer, was increased from £1,600 to £1,800 per annum.

Mr. Latimer Clark's Library.—It is stated in *Engineering* that the valuable collection of early scientific works made by the late Mr. Latimer Clark, F.R.S., has been purchased by Mr. S. S. Wheeler and presented to the American Institute of Electrical Engineers. Mr. Andrew Carnegie has offered to provide the large sum necessary to house the entire collection in its new quarters.

(*Continued on page* 761.)

KALGOORLIE POWER PLANT.

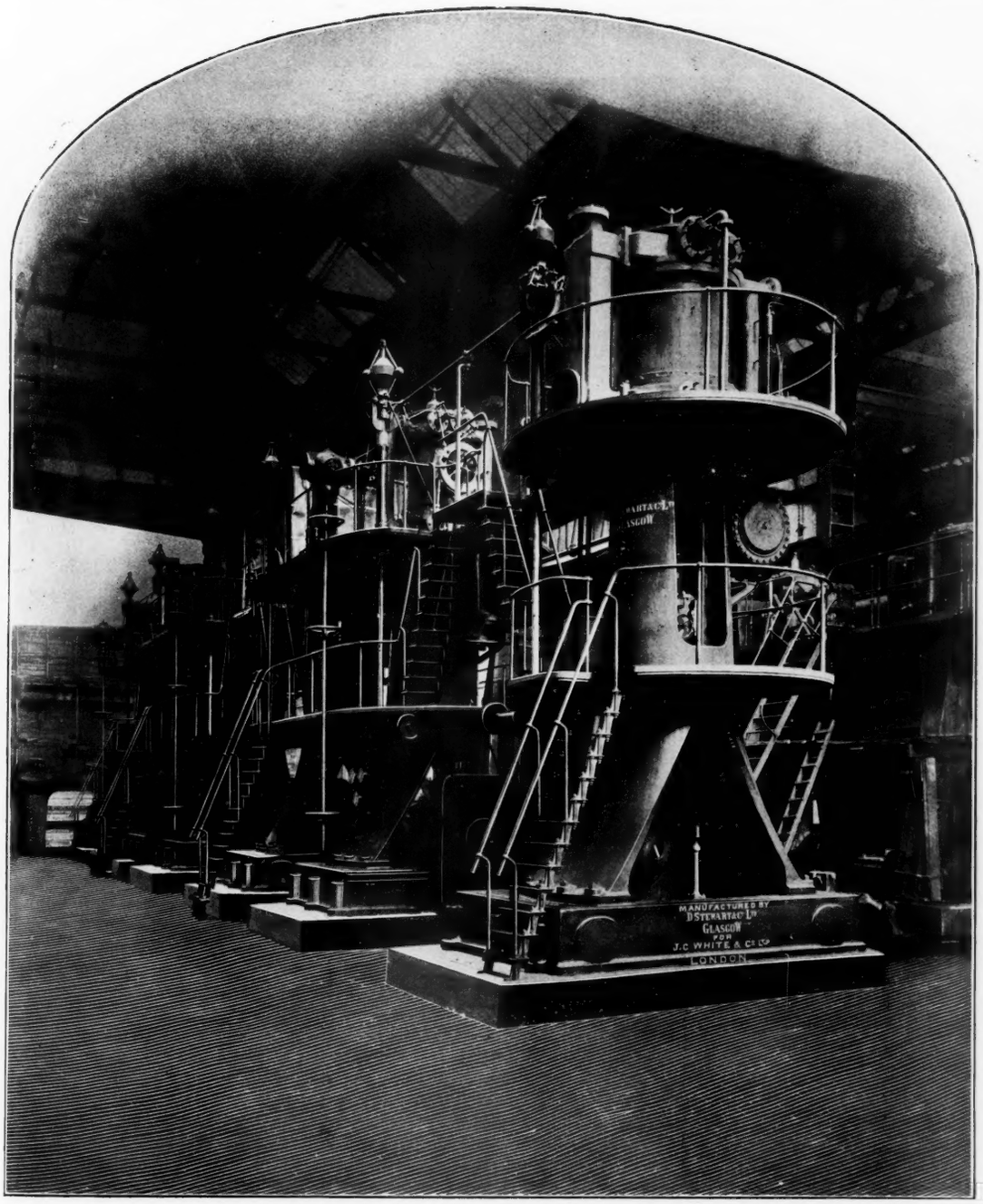
The accompanying photograph shows three 800-h.p. engines which have just been completed by Messrs. D. Stewart and Co., of Glasgow, for the Kalgoorlie Electric Power and Lighting Corporation, Limited, of Kalgoorlie, Western Australia.

The plant of this corporation will be unique and interesting, as the engineering difficulties to be overcome in its design are exceptionally great. There is at Kalgoorlie no fresh water to be obtained, all available water being a dense solution of salt and other mineral matter, varying in percentage of solid matter from 7 to 25 per cent. Even this water is not plentiful, the cost varying from 2s. 6d. to 5s. per 1,000 gallons. Water of this character can only be used in boilers after distillation, and in addition therefore to the high pressure boilers required for the Kalgoorlie Corporation's plant, a complete set of low pressure or evaporating boilers must be installed with condensers. These evaporating boilers are arranged to be used in relays, one set always being out of service for cleaning.

In a plant of this character it is obviously necessary to use the feed water over again, evaporating only a sufficient supply to make up for the losses. After a thorough study of all the conditions, it was decided to instal an aero condenser of the Fouché type. Although the most important function of this condenser is the condensation of the steam in order to again use it as feed water, the condensers are guaranteed to produce a vacuum of 35 centimetres of mercury, even with the air at the high temperature usual in Western Australia.

While these condensers entail a high capital expenditure for plant their depreciation will be only nominal, thus obviating the necessity for the heavy depreciation charges which must accompany any form of condenser using the very corrosive saline Kalgoorlie water.

The electrical apparatus for the plant will be of the three-phase alternating current type, manufactured by the General Electric Company, of America. Practically all the appa-



Three 800-h.p. Stewart Engines and General Electric (U.S.A.) Alternators

ratus, with the exception of the electrical machinery and the condensers (which latter are made in Paris), will be manufactured in England, and shipped complete to Australia.

The commercial advantages of a central station for supplying power to mining companies, where the difficulties of power generation are as great as they are at Kalgoorlie, are obvious. The individual small power user can never hope to obtain anything approaching the same economy of power generation which can be obtained by the large central station having a fairly uniform output throughout the 24 hours, and using the most modern eqnipment which can be purchased in Europe and America.

Rapid progress is now being made with the erection of the plant of this corporation, and it is expected that actual delivery of power will be made within a year from the present date.

The engineers and contractors for this plant are Messrs. J. G. White & Co., Limited.

ELECTRICAL LOCOMOTIVES.

In the following article a brief description is given of the locomotives on the City and South London Railway, which will be of special interest at the present time when electrical power is being applied to several of the new lines being opened up in different parts of London.

With the extensions of the City and South London Railway additional locomotives were required, and the directors decided that all new locomotives should be capable of hauling a four-coach train.

Sample locomotives were ordered, and at the same time Mr. P. V. M'Mahon, the company's engineer, was authorised to carry out a series of tests and experiments with the older type of locomotive, one of which was altered from the ordinary series rheostat to the series parallel control, and was tested under the new conditions in actual work.

Various curves giving the starting torque, acceleration, power consumption, &c., which were taken during these experiments, to arrive at data on which to base the calculations for these locomotives, are very fully set out in Mr. P. V. M'Mahon's paper, entitled "Electric Locomotives in Practice, and Tractive Resistance in Tunnels, with Notes on Electric Locomotive Design," read before the Institution of Electrical Engineers on May 4th, 1899.

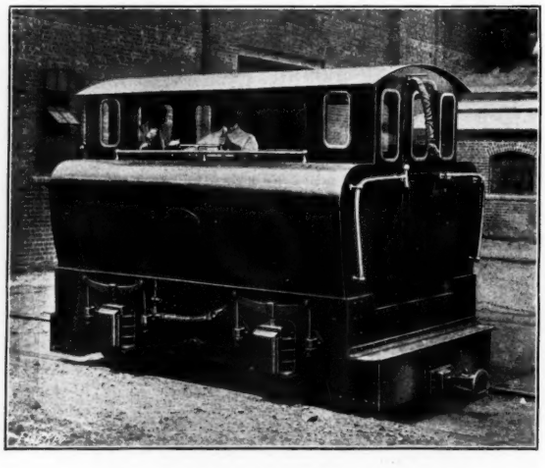


Fig. 1.—Crompton's Standard Light Locomotive.

From the data derived from these tests on the sample locomotive, a very complete specification was drawn up, including a set of curves of speed, tractive effort, and current at 500 volts.

Most of the well-known English and American electrical firms tendered on the above specification, and finally Messrs. Crompton & Co., Limited, of Chelmsford, were entrusted with the work. Some 16 of these locomotives are already running, and 14 more are shortly to be delivered.

It is satisfactory to find, now that so much machinery for electrical traction is being imported into this country, that the locomotives for this line have been made in England, and from what we can hear, cost a good deal less to maintain than foreign-made locomotives.

As will be gathered from fig. 1, which shows the locomotive complete, the cab is arranged with a door at each end, glass windows being provided on all sides to enable the driver to have a good view of the track, signals, &c. In the centre, at each end, will be seen a buffer, which is also used as a coupling. Panels of teak are arranged to line the inside of the cab, and for the sake of convenience, these panels are arranged so as to be easily removable.

Fig. 2.—Armature for Locomotive Motor.

As the resistances fixed inside the cab might be a source of trouble by scorching this woodwork, all the parts likely to be affected by the heat are carefully covered with asbestos sheet.

The floor of the cab is double, being made up of a wooden one, divided into sections, and underneath this an iron one.

In order to enable the driver to have a clear view of the commutators at any moment, glass windows, protected by grids, are fixed in the floor, and in this way, without stopping, he can see exactly what is happening to the commutators. In all, three lighting circuits are fixed inside the locomotive, two being intended for the locomotive lights, whilst the third is used for the train lights. These three circuits are naturally controlled by quite separate switches.

For the sake of safety, two oil-burning lamps are fitted on the locomotive, in addition to the electric lights, and these oil lamps are fitted with red, white and dark slides behind the lens.

These lamps are supported on brackets, which are rivetted to the side of the cab.

The following dimensions will give an idea of the sizes of the locomotives :—

Gauge	4 ft. 8½ in.
Overall height above rail	8 ft. 5½ in.
Overall length, buffer to buffer ...	14 ft. 2 in.
Extreme width	6 ft. 10 in.
Diameter of wheels	2 ft. 7 in.
Weight of locomotive	13 tons.

Each locomotive is fitted with two four-pole series wound ironclad motors, each motor being direct coupled on the locomotive axle.

Although at the present time the question of using a geared motor in place of direct coupling is being discussed by engineers, from the satisfactory working of these locomotives, it would appear that for this size and weight of train, direct coupling will take a good deal of beating.

By gearing the motors a good deal of the dead weight is transferred from the axles by means of spring suspension, which may no doubt be advisable in some cases, but at the same time introduces difficulties which direct coupling obviates. In fig. 2 is shown the armature direct coupled on the axle, whilst fig. 3 shows the motor complete.

Sufficient margin has been allowed in the motors, that one is capable of hauling the train by itself, should, for any reason, the other one become disabled.

To meet these conditions, the motors are tested at the maker's works coupled together, the one acting as generator, and the other as motor, and in this way the output of the motor is kept steady at 50 amperes 500 volts, and after a six hours' run at full load the temperature is not allowed to exceed 90° F.

The motors are capable of running in either direction under all conditions of load, without shifting the brushes, and without deleterious sparking. At 50 amperes the

commercial efficiency of the motors does not drop below 83 per cent.

Armatures.—These are of the drum type, and slotted, the cores being built up of steel discs, and separated one from the other by a thin layer of varnished paper before being mounted direct on the axle. No spider has been used in the armatures. The discs themselves are a tight fit on the shaft, and are driven by a key which runs the whole length of the core.

The end windings are supported on phosphor bronze end discs, which also lend rigidity to the core.

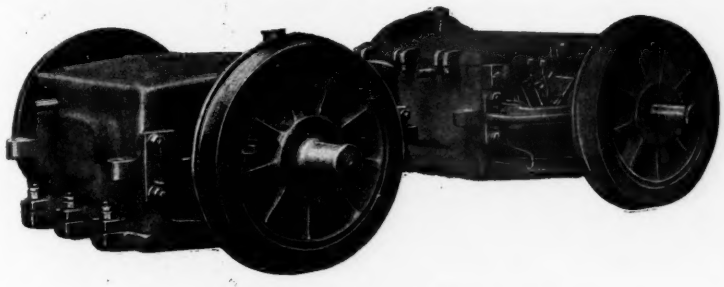


Fig. 3.—Complete Locomotive Motors.

Following the best practice, the coils are first shaped on a former, and then thoroughly insulated, after which they are placed in the slots. The slots, which have been prepared in such a way that all irregularities have been removed, are insulated by pressspahn troughs, which are laid in them. Finally hornbeam strips, which are dovetailed, are inserted in the slots over the winding. In this way the windings are held in position without binding wires, which are likely to be a source of trouble on motors working in this position.

Magnets.—The field magnets are made of cast-steel and are of the four-pole type, with exciting coils wound on two of the poles, and having two consequent poles. They are split across the diagonal corners for convenience in taking out the armature to meet the City and South London Railway conditions. The pole-pieces, which have been cast as part of the frame, have the field coils secured in place around them by means of bolts through the flanges. The lower pole-piece casting can be entirely removed by undoing the lower nuts in order to obtain access to the armature, and the pole-pieces are specially designed so that the axle, with the wheels and armature, can then be dropped out by taking up the car body. The whole of this operation can be quickly and easily carried out in the pits on the railway.

The side brackets or motor bearings, which are made of phosphor bronze, are split in a similar manner to the magnets, and the brasses to these bearings, which are designed for using solid grease, are $5\frac{7}{8}$ in. long. The field coils are wound on bobbins, made up of sheet-iron with brass ends, the joints being rivetted and soldered; in this way a very rigid bobbin is made. The former, or bobbin, is arranged at least $\frac{1}{8}$ in. larger than the pole, and is packed away therefrom with hard wood strips, which leaves a free air space between the bobbin and the pole.

In order, however, to prevent any movement, the bobbin is further securely fastened to the magnet frame. In this way there is no chance of any movement of the bobbin, in spite of the continual state of vibration of the motor.

Commutator.—The commutator, which has 151 hard rolled segments, is insulated throughout with mica: a high insulating ring is placed at the end of the commutator to prevent any flashing over to earth.

A wearing surface $5\frac{3}{4}$ in. long has been allowed, which will admit of a reduction of at least $2\frac{1}{4}$ in. in diameter in ordinary wear.

Although very satisfactory results have been obtained in the past with cast segments for traction work, it was considered preferable in the present case to use hard rolled segments.

Brushes.—The brush holders are arranged for carbon brushes, and are fixed 90° apart, in such a way that they stand on a line parallel to the floor of the cab. They are placed so as not to wear the commutator to a ridge at the centre.

Special attention has been paid to the accessibility and ease with which a brush can be removed and replaced from inside the cab.

Switch Gear.—The switch gear consists of two automatic magnetic blow-outs, placed in series with one another; each of them is capable of breaking the circuit with the largest current flowing. The autos are placed on the positive pole, and are covered so as to afford protection to the driver when used.

The motors are arranged for series parallel control, and for this purpose Mr. P. V. MacMahon's patent controller is used, with which excellent results have been obtained in practice. A description of this controller will be found later on.

In addition the following switches are fixed in the cab:—One reversing switch, one plugging switch for cutting out either of the motors, one main switch and automatic starter for the air compressor, and three S.P. switches and fuses for the lighting circuits.

A dead-beat ammeter reading 300—0—300 amperes is placed in the main circuit, and a tachometer, reading "miles per hour," is driven by a flat leather belt from the axle.

All the switches belonging to the control of the locomotive are placed on one side of the cab, whilst the compressor switches, &c., belonging to the brake gear are fixed on the opposite side. In this way the two are kept distinctly apart. The switch gear in position is shown in fig. 4.

The success of an electrical locomotive depends very largely upon the controlling arrangements adopted, and as the controller shown in fig. 5, designed and patented by Mr. P. V. McMahon, and made by Messrs. Crompton, of Chelmsford, has met with unusual success, it will be described in detail.

The controller consists of two switches operated by a single handle, that part of the controller which puts the motors into parallel being moved at only predetermined points. The regulating resistance of this controller is purposely divided into a large number of parts, bad flashing being thereby entirely avoided.

It has been found that the motors are put into parallel practically without any flashing on the contacts, and they

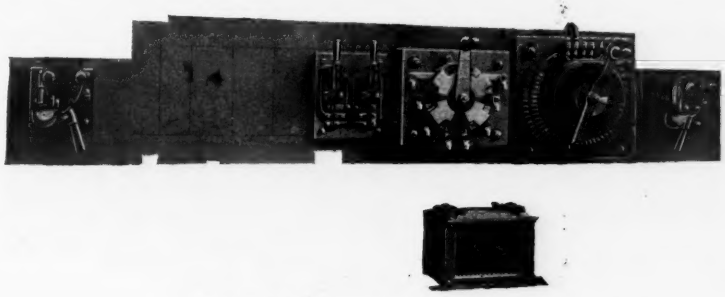


Fig. 4.—Locomotive Switch Gear.

are not put back into the series position again until the current is switched off the locomotive.

As will be gathered from the illustration of the controller, the motion of the switch is a turning one, and as the switch is moved round, the following stages are passed through:—(1) Two motors in series—resistance gradually cut out; (2) two motors in series, some resistance in—No. 2 motor on short circuit; (3) No. 1 motor running, No. 2 motor cut out, some resistance in circuit; (4) Nos. 1 and 2 motors running in parallel, some resistance in circuit; (5) Nos. 1 and 2 motors in parallel, all the resistance out.

It has not been found necessary to lock the paralleling part of the switch to avoid short circuiting, when the motor

is cut out of circuit, as this contingency is provided for in the switch used for cutting out a motor.

Collecting Gear.—The collecting gear consists of two cast-iron shoes, which are mounted on the buffer beam. These shoes are secured to a teak block, and have a flexible copper connection in addition to the ordinary hinge.

Suspension.—The armature rests directly on the axle, and the cab is suspended in the usual way by means of ordinary laminated springs, which rest on the axle box. The magnets are suspended by springs from brackets fixed on the cab frame, thus ensuring the greater portion of the magnet weight being carried on the springs, and very little work being put on the bearings, which are simply used to ensure the armature running centrally in the field.

Brakes.—The arrangement of brake gear consists of a Westinghouse brake with two storage reservoirs, each of a capacity of about 18 cubic feet. They are capable of standing a working pressure of about 110 lbs. per square inch, and were tested by hydraulic pressure up to 160 lbs. per square inch. Two charging pipes are fitted, one at each side of the underframe, and the two train pipes are fixed one at each end of the cab. These pipes have been fitted with the standard Westinghouse connection and rubber hose.

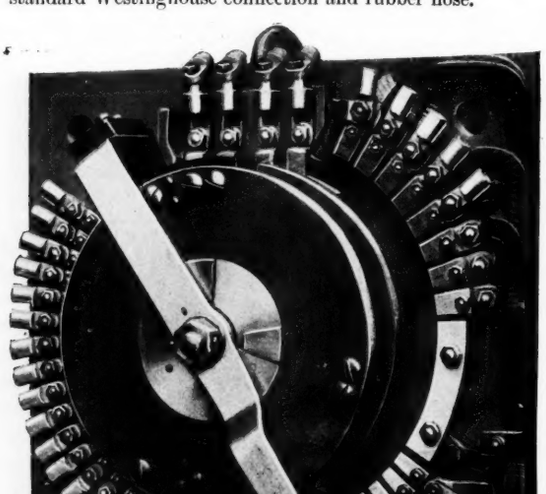


Fig. 5.—P. V. McMahon's Series Parallel Controller.

An electric air compressor, with starting switch and resistance, is also provided. This compressor, and the reservoirs, cylinders, valves, &c., were coupled up and tested with the following result:—With a pressure of 90 lbs., the leakage did not exceed an amount that lowered the pressure in the reservoirs to 89·5 lbs. in 60 minutes. A powerful hand brake, with a mild steel case-hardened screw and nut, is also fixed.

The driver's air-valve is of the City and South London Railway Company's standard pattern, and is fixed in a position clear of the woodwork.

The air-brake piston crosshead has a slotted link, so that when the hand brake is used, the piston remains stationary. The hand brake handle, however, is arranged to rise when the air-brake is applied.

The release valve for the locomotive brakes is placed close to the driver's valve, and at about the same level, while the triple valve and all the cocks and other valves are placed in positions easily accessible to the driver. All drains have been led outside the cab. The brake blocks are of cast-iron, and each block has independent adjustment.

In conclusion, we are indebted to Mr. P. V. M'Mahon, the chief engineer to the line, who is largely responsible for the design of these locomotives, and to Messrs. Crompton and Co., of Chelmsford, the makers of the locomotives, for the particulars which have enabled us to prepare the above article.

Blast Furnace Gases in the Manufacture of Calcium Carbide.—After a long series of experiments, a Dortmund firm has begun to erect a factory for manufacturing calcium carbide at Borbeck, near Essen, using blast furnace gases obtained from the neighbouring Phœnix ironworks as the source of power. Plant equal to 2,000 H.P. is to be laid down, including a 1,000-H.P. Oechelhäuser engine, an English engine of unmentioned size and maker, and a 1,000-H.P. Berlin alternator. The preliminary experiments were carried out by means of three small discontinuous carbide ovens, but these are to be superseded by several 500-H.P. furnaces built on the Nikolai principle. According to the published description, this apparatus is of the continuous type. The actual furnace is a shallow horizontal trough curved to form the circumference of a wheel which is constantly revolved by gearing. This wheel is connected through its supports with one pole of the dynamo. At one fixed spot as the trough travels round a mixture of lime and coke is fed in with the aid of a worm, next the mass arrives under a hood where the second electrode is fixed and where the carbide is produced; but before the revolution is complete, the finished material is withdrawn from the traveller by a suitable scoop, and thus the trough is once again empty when it reaches the place where the fresh charge is ready for insertion. This furnace is stated to be in actual work in a factory in Spain, where it has given so much satisfaction that the plant is in process of enlargement; but it would not be surprising to hear that the apparatus has been modified in several important particulars since it was first illustrated in print and patented.

Amalgamated Contacts.—Some interesting tests on contact resistances, made at the Ecole d'Electricité, are published in *Traction and Transmission* for April. Railbonds on electric tramways, and the contacts of switchboards, have to carry very large currents without overheating, and with a minimum drop of potential. The usual method of connecting rails is to bore one or more holes through the end of each rail, and to insert the terminal of a copper bond, which is expanded into the hole by various mechanical means, such as by driving in a conical plug. The copper and steel surfaces are thus pressed in contact with immense force, but in the course of time moisture gets between the surfaces and oxidises them, thereby giving rise to a great increase of resistance. With the greatest pressures it is impossible to get completely rid of this layer of oxide. Considerable success, however, appears to have been achieved in this direction by the well-known Edison-Brown amalgamated contacts, where chemical rather than mechanical means have been employed to remove the objectionable oxygen. The amalgamation by the Edison-Brown process is effected by a caustic amalgam, which is rubbed on the surface of the steel and copper plate after the same has been wetted with water. The amalgam appears to absorb the oxygen from the oxide, leaving pure metallic iron or copper and a layer of nascent mercury, which at once unites with the metals to form a layer of adherent amalgam. In the tests at the Ecole d'Electricité, a current of 1,770 amperes, passing from one steel rail to another through an ordinary copper bond, heated it in three minutes to 210° F. A test made with an Edison-Brown amalgamated bond of equal surface, showed that after a current of 1,800 amperes had been passed through it for five minutes, the hand could be held on the copper bond without discomfort. The potential drop in the latter case was only one-fifth of that in the former.

Nitrogen from the Air.—The New York *Sun* says:—"We learn from a competent authority that one of the latest developments in electrothermics is the synthesis of the oxides of nitrogen from atmospheric air. The importance of such a discovery to the world at large cannot be overestimated. Nitrogen, of course, is the base of all fertilisers. While it is not in existence in natural beds of nitrate deposits in anything like sufficient quantity to supply fertilising material, Sir William Crookes pointed out that if a method of fixing atmospheric nitrogen could be discovered it would solve the difficulty. If this method has now been found we have before us one of the greatest boons that have ever come to the human race."

NOTES.

(*Continued from page* 756.)

Electric Freight Railways. — In the new journal, *Traction and Transmission*, Mr. Gibbings presents the first of a series of articles on the conveyance of goods by electric trolley lines. He refers particularly to the small cost of carriage in America, and to the choking effect of the railway ownership of so many English canals. While the cost of carriage has been reduced in the last few years by one-half in America, it has actually increased in this country; but surely much of this is due to the mismanagement from which all our lines suffer. American railways are usually managed by men of some training. English lines are run, as regards their directorates, too largely by men whose only title to be on such boards is a title. We fully believe our railways would pay better on lower charges, in the hands of good management. Mr. Gibbings is specially pleading for his own scheme for carrying goods in South Lancashire, but he only gets through a few preliminaries in this first article. Terminal expenses, of course, are the great incubus on traffic. Thus at Liverpool there are 5,000 horses engaged in trucking goods from ship to railway. This is ridiculous, of course, and ought not to be the case. In all cases the truck should be run on rails right up to the ship's side, in place of the goods being carried two miles, then deposited in a shed, and handled two, or even three, times between ship and railway. Mr. Gibbings's first article contains a map of the electric lines of South Lancashire, and a table of railway rates from Liverpool to towns within that area, rates that are ridiculously high, and that compelled the construction of the Ship Canal. Our author makes out a good case for better facilities, as indeed is only too easy. We look forward with interest to what he may have to suggest as a remedy in connection with electric traction. In the meantime we note that the gauges of the electric lines in Lancashire are variously 4 ft. 8½ in.; 3 ft. 6 in.; 4 ft. It would be well if tramway people would take a lesson from the history of the railway gauges.

Boilers at the Paris Exhibition.—The *Engineer* has commenced a serial on the boilers at the Paris Exhibition. As with almost all other mechanical appliances, English boilers differ from others in their severe and rigid simplicity. This may, or may not, be praiseworthy, but it is again impressed on us by some of the examples culled at Paris. A water-tube boiler by Bietrix, Nicolet & Co. has a detail of some novelty and interest. The boiler is of the well-known form, of which the Babcock is the most prominent example, with long sloping tubes and headers, but it differs from that type in having the openings of the headers into the steam drum connected by a horizontal pipe, with ends curved down to the said openings. The pipe has a slit in its upper side to allow steam to escape, and is perforated near the down-take end, but otherwise there is not a free communication between this pipe and the water in the drum, and the water in the tube system practically circulates round and round until completely evaporated, the portion converted into steam being replaced by inflow through the perforations. Possibly the advantage, if any, in this arrangement, is that when once established in circulation, no check is placed upon the water continuing to circulate. Once in movement, it tends to keep on moving, whereas, if discharged into the drum freely and loosely, it is deprived of its movement, and this has to be freshly imparted to each atom of circulatory water.

In the boiler of Berninghause & Co., the part that holds the furnaces is practically a short Lancashire boiler, connected by a short trunk or flanged mounting piece to an upper drum of about equal length and diameter, which is nearly filled with smoke tubes. The obvious danger of this design is the connection of two large and heavy shells by means of a throat piece. There is a risk that the constructive parallelism of the shells may not be maintained, and that great shell stresses may be set up by any deviation from such parallelism that may occur as the result of settlement. The same firm had also a plain cylinder three-tube boiler, about 8 ft. 6 in. diameter, with two upper tubes of about 36 in. diameter and a lower one of 30 in., the length being 33 ft.

One H. Paucksch shows a Cornish double boiler, with two shells of about 6½ ft. and flue tubes of 36 in. placed eccentrically, as sometimes practised with Cornish boilers in this country. Large steam domes are used, and the boilers are seated, on a now obsolete and dangerous plan, upon brick midfeathers, that would be at once condemned by any responsible boiler insurance company as liable to lead to danger.

The Adamson flanged seam is employed to join the rings of tube, which are made to vary in diameter with the idea of better mixing the gases, and deeply projecting, with a view to carry heat into the water. Our contemporary makes much of this extra cooling surface, but we should think more of it if the ribs projected on the fire side as heat absorbers. A plate can always be relieved on the water side pretty thoroughly by clean water of all the heat it can absorb on the fire side. There is a practical objection to high projecting ribs on a furnace tube; they are liable to be so well cooled off, being watered on both sides, and far from the source of heat, that they split on their extreme edges owing to the expansion of the hot furnace tube. ⊥-hoops, formerly much used as jointing rings in Lancashire boilers, used frequently to split from this cause right across the vertical web. We might point out that of the features commented on by our contemporary in this boiler, what is good is not new, and what is bad has been known sufficiently long to have been now avoided. For example, much is made of the fact that these tubes carry their own weight, not being stayed by suspension stays. Tubes equally long in proportion have for long enough done the same in Lancashire boilers. Apart from the dangerous midfeather seating, the outer external flues are encumbered with a mass of useless brickwork, the only use of which is to obstruct proper inspection. Of the boilers named, all but the first are German, and are not worthy of imitation. They serve but to illustrate that long exploded methods still endure, even among the "highly instructed" continentals. They are examples to be avoided when compared with English boilers.

The Coal Tax.—The price of bituminous coal in London since the rise has been 20s. per ton in excess of the ruling price during at least 10 previous years. The coalowners put the price up ostensibly because of the war, which, however, could have had but very little real effect upon the price. The annual coal production of the country is 200 millions of tons, so that the coal interest is, and has been, squeezing 200 millions in gold out of the British public more than it was wont to do. The extra cost of coal to a London householder of moderate means is thus more than his extra income-tax. Yet the proposal to tax about one-tenth of the coal output only 1s., or about the equivalent of 2d. per ton on all the coal raised, has brought about the disgraceful spectacle of weeping coal millionaires. They howl over 2d. per ton, all of which they can compel the foreigner to pay. They grudge, in fact, paying back 1½ millions of the 200 millions they have squeezed out of their poorer fellow-countrymen!

The Marylebone Competition Question.—The Electric Lighting Provisional Orders (No. 1) Bill, which was down for second reading in the House of Commons "by order" on Monday last, has been postponed by arrangement until May 9th. The *Times* states that this has been arranged so that an opportunity may be afforded for considering whether the provisions of the Lands Clauses Act as to expropriation cannot be embodied in the measure for dealing with the case of the Metropolitan Electric Supply Company.

Röntgen Society.—At yesterday's meeting held at Hanover Square, Dr. Dawson Turner showed a new form of mechanical interrupter. A paper was read by Mr. James Cadett on "Some X ray Improvements." On June 6th, a paper will be read by Dr. Hugh Walsham on "X ray Diagnosis of Aneurism," with lantern demonstration.

Advice to Engineers.—Our very interesting exchange, the *American Machinist*, quotes the following instructions for engineers from the *American Thresherman*. They are written, of course, for the drivers of engines employed in agricultural work, but many of the items apply to the running of small engines and boilers everywhere :—

When your engine is running well, do a little monkeying; keep tightening up; it will give the feeders a rest.

Remove your fusible plug and put in a hard one; a soft plug is annoying when it melts.

Do not try your gauge cocks; they are only ornaments.

It is a dirty job cleaning flues; let them alone.

Let your cylinder growl; it is music to a good engineer.

Tighten your glands until the rods get hot; it is good for packing manufacturers.

Pour on lots of oil; it looks nice to see it run over the boiler and upon the ground.

Keep your engine pounding so that the neighbours will hear it; it is a good advertisement.

Shut your furnace door tight when you light your fire; it will give you lots of time for gossip.

Do not sweep out your smoke box; let it rust out.

Do not clean your engine when it breaks down; the broken part is much easier to handle.

Do not try your safety valve; you are liable to get to heaven sooner than you expect.

Never blow out your lubricator; it is only a waste of steam.

Do not grease your gears; they will wear out the sooner.

Do not oil your road wheels till you cut out the hub; you can get a new pair for a dollar.

Take off your governor belt, especially on hard, stony roads; you will need a new engine all the sooner.

Do not look your engine over when moving; when it breaks down you can walk the rest of the way.

Never tighten your mud guards till they get between the gears; you will have lots of time later to fix them.

When you tighten nuts and bolts, pull until you over-haul them; there are lots of mechanics idle.

Do not clean your fire; your engine will steam easier full of clinkers.

Never look at the interior of your boiler; the more mud the less water you need.

In frosty weather, leave the pet cocks all closed; it costs nothing for repairs.

Never oil your governor with kerosene; when it gets gummed up you will get to your destination all the sooner.

And above all, when your employer is engaged with anyone, leave your engine and listen to what is going on; you may be able to transact his business some day.

The Post Office Order for American Telephones.—A correspondent writes us to the following effect :—The large order recently placed by the British postal authorities with American telephone manufacturers is of the greatest interest and importance, not only on account of its possible consequences, but as an illustration of the iniquity of our Company and Patent Laws and of the P.O. Department.

In order to fully appreciate these things it should be borne in mind that, although the telephone was invented in America, the first practical instrument was made and installed in England. British manufacturers promptly took up the matter, and in a few years the industry of manufacturing telephones was well established in this country. Unfortunately, however, the patents were acquired by a company, which at once proceeded to strangle the industry most effectually, and instead of manufacturing on a large scale, bought millions of pounds' worth of apparatus in America and on the Continent during the next 10 years, thus giving foreign manufacturers a splendid start over us, and causing a loss of at least 20 millions to this country.

Even when the patents lapsed, there was practically no improvement; the National Telephone Company bought up competitors, and continued to pour British capital into the hands of foreign manufacturers. Patriotism appears to have been at a discount.

The next chance occurred when the Post Office obtained a grant of two millions sterling for telephones, and Mr. Hanbury expressed the pious hope "that a trade for making telephonic instruments will be established in this country." The Post Office got the money—and now places the order in America.

In the first place, it is clear that it should be made impossible for any patent to be upheld in this country unless either fair licenses are granted to British manufacturers, or a manufactory is established in Great Britain by the patentees.

Secondly, not only did that monopolist company kill the British industry, but, in doing so, it killed competition; the consequence has been that the company has itself been deprived of the benefits of competition.

Again, owing to the extinction of the industry, the Post Office no doubt finds it impossible at present to place a contract at home at anything like the prices quoted from abroad; for in order to prevent possible competition the large foreign manufacturers will not hesitate to put in very low tenders, perhaps even below cost price. This, however, will be but a temporary condition, and as soon as all fear is past the prices will go up higher than ever; in the end the country will pay dearly for the niggardliness of the Government.

In other lands the Government assists and protects home industries in every possible way; here, the private manufacturer is not only left to fight for himself, without even a tax on imported goods, but he is even hampered, tied hand and foot by the British Government and municipal authorities. The latter, so far from recognising that private enterprise is the life of industry, look upon it as a greedy monopoly.

No doubt the spectacle of the British manufacturer struggling against his competitors with his hands bound is magnificent; but it is not good business.

A New Double-Tube Water-Tube Boiler.—Now is the time for a crop of new boilers! One such is described in a paper read before the Institute of Naval Architects by Mr. Irving. It is of the double-tube form, that is to say, through the water tubes are threaded smaller fire tubes, with the view of heating the water on both sides, the furnace gases rising up as in most water-tube boilers between the tubes, and then passing to the back of the boiler and returning by the inner tubes. There are thus four tube plates, each pair going to form a water leg through which the fire tubes pass. In the middle of the nest of tubes is a combustion chamber made by omitting a number of tubes. This is not a very scientific place for a combustion chamber—it reminds us of the combustion chamber of the Webb locomotive boiler, which is placed at the end of a set of fire tubes where the cooled gases cannot be expected to burn. Similarly in the boiler before us the gases are first cooled among the water tubes and then expected to burn in this cold walled combustion space. It is too ridiculous to see how one water-tube designer after another persists in attempting to burn cooled gases, and puts all his ideas into attempting to overcome mechanical difficulties of construction, as though such a subject as the chemistry of combustion had no existence. The inventors made tests with a couple of rows of tubes and found no ill-effects, but in the actual boiler there are nine rows of tubes, and these must offer more resistance, especially as there is no free down-comer to carry water to the lower and most highly heated tubes. At the same time, it is stated that a boiler has been at work over three years and has required no repair; it has been worked with Scotch coal, and has air holes provided all round the furnace, in the endeavour to promote full combustion, presumably before the gases enter between the tubes. Surely this is something after the manner of the Belleville, which, however, still made smoke; we think that whatever other merits this new boiler may possess, it will probably make a good deal of smoke, and will almost certainly do so with a long-flaming coal, whatever it may do with Welsh or with short-flaming coal.

Water-tube Boiler Explosion.—A terrible water-tube boiler explosion is reported from America. It took place at Sherman, a small place between Los Angeles and Santa Monica, Col., at the power plant of the Posadena and Pacific Railway Company. It was not the first explosion which had taken place. The battery was of 2,500 H.P., and had been in use five years. The explosion took place during the night, and the power house was completely wrecked.

Electrical Exhibition.—A "twentieth century" electrical exhibition is to be held at the Royal Aquarium, Westminster, from December 16th, 1901, to January 26th, 1902. Prospectuses are already out.

McDonnell v. Heyl-Dia.—With reference to the report of this case in our last issue, Mr. G. E. Heyl-Dia writes to state certain corrections. He says :—"The plaintiff was in the employ of the St. Helens Cable Company, Limited—not in my employ. *Ergo*, he could not have rendered me any services." Our correspondent proceeds :—"The defence showed that I had conditionally promised the plaintiff a gift of 10 fully paid up shares, my personal property, as an inducement to assist as much as possible in the starting of the company's plant. A transfer, not a certificate, was signed by me, but not completed, not being witnessed nor stamped, and was left in my custody after having been signed by plaintiff. There never was a certificate, nor did I ever hand over a certificate to plaintiff for splitting up and registration (I have no register). A free gift it would have been if all this would have been done that has not been done. However, it suffices to make quite clear that there was no unlawful retention of another man's property on my part. The judgment was based as a matter of course upon the pleadings which stated that the shares had been given as an *escroc*, and as these cannot be corrected, the plaintiff has to thank the solicitor who drew them for the unexpected increase in his worldly possessions."

Overhead Wire Accidents.—Mr. G. H. Julius contributes an interesting note to a French exchange upon the protection of telephone wires from accidental contact with trolley wires on electric tramways. In the course of the construction of about 20 miles of tramway in Algiers, operating on the trolley system, Mr. Julius made some experiments with reference to means to be adopted for the protection of telephone wires which will interest those occupied in the same direction. It appears that in Algiers the postal authorities insisted upon the erection of guard wires of galvanised steel, three wires being run above each trolley wire. It was expressly stipulated that these wires should be insulated from earth. The result was not a happy one; in the first place, every break on the guard wire caused by derailment or by unskilful handling of the trolley, absolutely disorganised the service, because these steel guard wires in breaking coiled themselves round the insulators which supported the trolley wires and often round the trolley wires themselves thus causing short circuits, which at times might be of extremely short duration, perhaps only momentary if the guard wires fell against the trolley wires and rebounded without coiling themselves. The contact was, however, sufficiently long to operate all the automatic circuit breakers in the section affected, which, of course, gave rise to very great inconvenience.

If the guard wires had been properly connected to earth, as is done everywhere, it is more than probable that any telephone wire falling upon the high-tension trolley wire would have been immediately fused, and the short circuit automatically relieved. Under the conditions, however, where guard wires were insulated, it became necessary to repair the trouble before the service of cars could be reinstated. A break of an insulated guard wire, however, sometimes brought with it more serious consequences; for instance, cases were known of a piece of guard wire insulated at one end from earth, but touching one of the trolley wires, being suspended from a trolley wire at a quite convenient height to come in contact with passers by. Three or four horses and mules were killed in this way on different occasions, and about the beginning of the year 1899, an Arab, who was walking below, very probably on the rails, happened to touch the broken guard wire out of curiosity. His impressions were not recorded, he was immediately killed. This is a somewhat unusual case, as the E.M.F. was only 500 volts continuous current, but at the inquest it was shown that the victim suffered from alcoholism, and besides that had a weak heart.

In course of time the Post Office authorities began to realise that they had made a mistake, and sought to remedy it, but instead of simply specifying that guard wires should be earthed, they insisted upon all guard wires being replaced by wires composed of an insulating material, leaving to the unfortunate company the somewhat difficult task of discovering this particular material. Experiments were made with ropes of tarred hemp, and, indeed, the results were rather better than had been anticipated, as they acted very well for several months. They also possessed this advantage, that they could be erected or repaired with ease and great rapidity. On the other hand, they were very sensitive to changes in the hygroscopic conditions of the atmosphere. Fortunately—as Mr. Julius humorously remarks—they were never called upon to show their efficacy as guard ropes, inasmuch as no break of any telephonic wire occurred during the period that the tarred hemp was experimented with.

The experiments were not continued for any length of time, as the postal authorities decided upon the erection (at the company's expense) of protective nets stretched under the telephonic wires. Mr. Julius, in conclusion, expresses the opinion that although the latter expedient is not pretty, it appears to him to be the only one which is really efficacious, and which does not involve any risk of interference with the ordinary operation of the electric tramway. Mr. Julius further delivers himself of what would appear to be a somewhat superfluous piece of advice, namely, that he would not recommend anyone to continue the search for a rope made of insulating material. No doubt, however, this is "writ sarkastic."

Liquid Fuel.—The Engineers and Shipbuilders' Institute recently listened to a paper on liquid fuel from Mr. Orde, who discussed the methods of burning oil. First, there is the system of mechanical spraying of oil by means of its own pressure—a system that requires a firebrick-lined furnace. It is said to require a large furnace capacity and a large excess of air, but the system is simple and noiseless, and 12½ lbs. of evaporation has been secured which represents 64·6 per cent. efficiency with Borneo oil. The second system includes the admission of the oil as a gaseous spray by means of steam or air. A partial lining of firebrick is required in this system also, together with brick bridges and baffles. This is in part the system used by Mr. Holden on the Great Eastern Railway, but he uses a thin firebed also of coal and chalk. Mr. Orde claims an evaporation of 13 to 14 lbs. by the second system. He regards the third system as the most promising. This involves complete vaporisation of the oil. This has been attempted by Dorsett and Blyth by boiling the oil in one boiler and burning it in the furnace of the steam boiler; and by Thwaite by means of a retort to receive a spray of steam and oil, the vapour coming out through holes and burning. Mr. Orde thinks this system is apt to produce retort carbon. Mr. Orde recommends that oil should by raised to near the boiling point and only then admitted into the presence of superheated steam. The vapour is milk white, easily condensed, and very acrid. It is burned over a layer of broken firebrick, first probably as acetylene and finally as hydrogen and carbonic oxide. The efficiency is 15 to 16 lbs. of water evaporated (as above) from, and at, 212° F. The objection to a steam spray at sea is, of course, the waste of fresh water, but the author sums up the advantage of liquid fuel as a 40 per cent. reduction of fuel as compared with coal; a reduced bunker space of 15 per cent. per unit weight of fuel, and of 50 per cent. for the same radius of action, and of 50 per cent. in stokehold staff. In discussing the question, Mr. Traill considered that Mr. Orde had understated the efficiency of the first-named method, for he had himself obtained 14 to 15 lbs. of evaporation, retaining the furnace bars and covering them with bricks broken up. Air was used as the spraying agent. It is better to separate water from the oil, and he recommends the Flannery-Boyd system, but does not describe it, The chief trouble about oil fuel seems to be the structural expense connected with the bunkers and ballast tanks when these are used as oil tanks, as they may be.

Liverpool Engineering Society.—At the annual general meeting of the Liverpool Engineering Society held last week, Mr. Arthur Musker, of Messrs. C. & A. Musker, Limited, was nominated for the presidency. The report of the Council, which was submitted by Mr. R. C. F. Annett, mentioned that the Derby gold medal had been awarded to Mr. T. L. Miller for a paper on "Electrical Distribution in Cities," and the society's premium had been awarded to Mr David Brown for a paper on "Defects in Iron Castings."

Personal.—Mr. W. Langdon.—At the present time it will be of interest to those of our readers who belong to the Institution of Electrical Engineers to know some details of the career of one of their vice-presidents, whose high standing in electrical engineering is exceeded only by his modesty. In Mr. Langdon we have a representative of those who served under the pioneers of telegraphy, who has kept well in line with modern electrical engineering. Born in 1833, son of Commander John Weeks Langdon, R.N., assistant hydrographer at the Admiralty, and inheriting his father's scientific bent, at the age of 19 he entered in 1852 the service of the Electric and International Telegraph Company, in which he soon came to the front as a junior engineer. When the telegraphs of the United Kingdom in 1870 were transferred to the Post Office, Mr. Langdon rapidly passed from the charge of the telegraphs of the South-Western Railway to the service of the Post Office, in which he occupied the important post of assistant divisional engineer until 1878, when he was appointed, on the recommendation of his then chief, Mr. (now Sir William) Preece, to the charge of the electrical department of the Midland Railway Company, which office he still holds. To Mr. Langdon is credited the complete reorganisation of the block system, and since 1880 some of the most important trunk telegraph and telephone lines in the kingdom have been erected and maintained for the service of the Post Office on the Midland Railway. The rapid expansion of the electrical engineering needs of a railway company may be realised, when it is understood that under Mr. Langdon the mileage of wire has increased from 8,000 to 27,000, and the instruments in use from 7,000 to 20,000. At present, the ever increasing requirements of a great railway company for the applications of electrical engineering require the use of over 1,000 telegraph stations, 1,070 posts where block signalling is established, and 11 stations where electrical energy for lighting and other purposes is generated. The latter have a collective output of some 5 million units. It will not be wondered at, that some 1,900 to 2,000 employés in these various undertakings look to Mr. Langdon for guidance. Besides being an able inventor in the improvement of the appliances which are in his charge, he has not failed to provide that the systems of which he has control shall apply all the most modern improvements—for instance, such as quadruplex telegraphing—which the railway authorities allow him to adopt. To Mr. Langdon, who joined the Institution (then the Society of Telegraph Engineers) in 1872, was due its gratitude, when in 1877, at a moment of emergency, he volunteered to act (in addition to his official duties) as secretary for 11 months. The grateful and appreciative wording of the Council's minute, when he ceased to act, shows the importance of the service then rendered. Like many others of its distinguished members Mr. Langdon, owing to his residence away from London, was not, until 1895, able to become a candidate for the Council, but he was elected that year and has served continuously since, first as member, and for the last three years as a vice-president. He is the author of papers read before the Institution in the years 1874, 1876, 1877, 1895, 1896, 1898 and 1900.

It is announced that Mr. Marconi has become engaged to Miss Josephine Holman, of Indianapolis.

The New York *Electrical World* says that Messrs. F. H. Nalder and P. A. Ransom, who have been making a rapid tour through the manufacturing districts of the States, besides visiting Canada, have sailed on their return to England. Mr. Nalder met many old electrical friends, who were glad to see him on this side again. Many establishments were thrown open wide to them, and a warm welcome met them everywhere.

Lectures.—A special summer course of lectures on "Electric Lighting Plant Tests" is to be delivered at the South-Western Polytechnic, Manresa Road, Chelsea, S.W., on May 16th, 23rd, 30th and June 6th, 13th, and 20th. Electrical students should apply personally or by letter to Prof. Schwartz, and mechanical students to Prof. Pullen.

Special courses of lectures by Mr. J. T. Morris, on "Electric Traction," and "Capacity in Alternating Current Work," are being arranged for at the East London Technical College, commencing next week. See advertisement pages for details.

Glasgow Exhibition.—The International Exhibition, for which Glasgow and most industrial people have been making such great preparations, was opened at midday on Thursday by the Duke and Duchess of Fife amid scenes of great enthusiasm. The general public was admitted in the afternoon, and all Glasgow gave itself up to holiday making. The Duke, in the name of the King, wished every success to the Exhibition. A general round of the Machinery Hall and several other sections proves that the whole is sufficiently advanced to render a visit both profitable and interesting to electrical men.

Glasgow.—The Corporation have now decided to go on with the new bye-laws for regulating the street traffic. They propose to confine the slow traffic to the side of the streets, leaving the centre for the new cars and other fast going traffic. Several conferences have already taken place between the Committee and the principal contractors. An enormous traffic was done on the new electric routes opened last Saturday. A slight hitch occurred on Monday to the 5,000 H.P. alternating sets, but by switching in the 1,000 H.P. direct current sets, traffic was immediately resumed.

Appointments Vacant.—A shift engineer is wanted for the Bexhill electricity works. An assistant draughtsman is wanted for the Sheffield electric tramways department. A resident electrical engineer is wanted at Heckmondwike at £156 per annum. The Farnworth Electricity Committee wants an assistant electrical engineer at £100 per annum. The Corporation of South Shields wants a chief electrical engineer, at a salary of £350 per annum. See "Official Notices" this week.

Belleville Boilers.—Replying to Mr. Allan in the House of Commons on Monday, Mr. Arnold-Forster said that the work in connection with the Belleville boilers of seven ships has been suspended. In the case of one ship, the *Lancaster*, the work has been ordered to be resumed, it having been found on inquiry that a change in the type of boiler at the present stage would involve great delay in the completion of this ship. This was the only case of withdrawal in which the work was ordered to be suspended.

Submarine Signalling.—According to a *Morning Post* correspondent, experiments are being carried on by the United States authorities, with some assistance from the British Government, to determine the utility of a system of submarine signalling by means of electric bells. Experiments with a new system are said to have been successful up to within 10 miles of the bells. The Naval Attaché of the British Embassy in Washington is preparing an elaborate report on the subject for his Government.

Marriage.—Mr. William Bewes Atkinson, electrical engineer in the extensive linoleum and oilcloth factory of Lord Ashton, at Lancaster, was married on Thursday, April 25th, to Miss Lillie E. Sewell, of Hubert Place, Lancaster, at the Centenary Congregational Church.

Appointments.—Mr. Fraser, electrical engineer, of Lancaster, has been appointed electrical engineer of Nelson, at a salary of £300 per annum.

Information Wanted.—We should be glad to know, on behalf of a reader, the address of the makers of "magnalium" wire.

NEW COMPANIES REGISTERED.

Incorporated Municipal Electrical Association (69,826).—This company was registered on April 15th, with an unlimited number of members, each liable for £1 in the event of winding-up, to promote the interests of municipal electrical undertakings, to bring municipal engineers and chairmen and members of municipal electrical committees together, to hold meetings for the discussion of subjects germane to municipal electrical undertakings, to establish a reading room, library and collection, &c. The word "Limited" is omitted from the title of the company by licence of the Board of Trade. The first subscribers are:—H. Faraday Proctor,

205, Redland Road, Bristol, electrical engineer; George Pearson, Bannerleigh, Woodland Road, Clifton, solicitor; William Maclay, Corn Exchange Buildings, Glasgow, confectioner; W. A. Chamen, 66, Partickhill Road, Glasgow, electrical engineer; Robert C. Quin, 83, Palatine Road, Blackpool, electrical engineer; Arthur Murray, Barrowdale, Walm Lane, Willesden Green, N.W., electrical engineer; and John F. C. Snell, Wearholme, Roker, Sunderland, electrical engineer. The management is vested in a council. Registered office, St. James's Hall, Piccadilly, W.

Gravesend and Northfleet Electric Tramways, Limited (69,877).—This company was registered on April 18th, with a capital of £80,000 in £5 shares, to carry on the business of carriers of passengers and goods, electricians, electrical and general engineers, contractors, manufacturers of and dealers in railway, tramway, electric, galvanic, magnetic and other apparatus, chemical engineers, generators, accumulators, transmitters, users and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, compressed air, gas, steam, oil or otherwise, tramway and railway constructors and owners, &c. The first subscribers (each with one share) are:—G. Stevens, Maycroft, Queen Ann Avenue, Bromley, Kent; E. Garcke, Donington House, Norfolk Street, W.C., managing director of British Electric Traction Company, Limited; J. F. Albright, 66, Victoria Street, S.W., electrical engineer; G. E. Medhurst, 208, Dulwich Rise, S.E., secretary; C. H. Dade, Donington House, Norfolk Street, W.C., secretary; J. Devonshire, 2, Stafford Terrace, Phillimore Gardens, W., electrical engineer; and W. J. Greer, Donington House, Norfolk Street, W.C., gentleman. Minimum cash subscription, one-third of any shares first offered to public. The number of directors is not to be less than three nor more than seven; the first are E. Garcke, G. Stevens, J. F. Albright, J. Devonshire, and W. J. Greer. Remuneration, £50 each per annum, and a share in the profits. Registered office, Donington House, Norfolk Street, Strand, W.C.

SUPPLY STATION ACCOUNTS.

Brompton and Kensington Electricity Accounts.

In our issues of March 1st and 8th, we gave the report presented and proceedings at the annual meeting of the Brompton Company. The accounts now analysed cover the last two years, and bear out the Chairman's statement that the satisfactory financial position is the result of the policy of the board and the efficient services of the manager, Mr. H. W. Bowden, and staff. Those who remember the old House-to-House Company, know that it was early in the field, but its location between the Brompton Cemetery and the District Railway rendered it difficult to find space for extensions. Concurrently with the change of name we find a change in plant. The last portion of the original plant has now been disposed of, and the engine house is fitted with direct coupled plant, resulting in such a saving of space that the present station will be sufficient for a long time to come. The total cost of the alterations is about £27,000, met by a renewals suspense account, of which £2,993 have been taken from last year's profits. The account now stands at £14,195.

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£186,212	**£207,701**	£21,489
Number of units sold	1,241,369	**1,494,106**	252,737
Total maximum load in KW. ...	1,105	**1,307**	202
Number of lamps connected ...	95,303	**108,978**	13,675
Gross revenue	£31,654	**£36,408**	£4,754
Gross expenditure	£12,236	**£14,801**	£2,565
Gross profit	£19,418	**£21,607**	£2,189
Average price per unit sold ...	5·59d.	**5·54d.**	−·05d.

The plant installed aggregates 2,160 KW. The rates charged are 6d. per unit for lighting with discounts, and 3d. for power. A trial is being made with public lighting, this company supplying energy to 7 600-watt arc lamps, and 14 32-C.P. incandescents for the purpose. The revenue statement shows a fall of over ¼d. on the total per unit which has brought the figure below 6d.

REVENUE STATEMENT.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£28,913	5·59d.	**£34,458**	5·54d.	−·05d.
Meter rents	1,491	·29d.	**1,659**	·27d.	−·02d.
Sale of lamps	—	—	—	—	—
Sundry transfer fees, interest, &c.	1,250	·24d.	**291**	·04d.	−·20d.
Gross revenue ...	£31,654	6·12d.	**£36,408**	5·85d.	−·27d.

All the items in the costs over which the engineer has control have been reduced. Coal of course shows the effect of last year's prices by an increase of nearly ½d. per unit, but about ¼d. is good for a London works of moderate output. The economies in various directions leave the total cost almost unaffected.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal and unloading, cartage of ashes, &c.	£3,649	·71d.	£5,176	**·83d.**	+·12d.
Oil, waste, water and engine room stores.	434	·08d.	450	**·07d.**	−·01d.
Wages, and proportion of salaries incurred in generation and distribution.	2,994	·58d.	3,545	**·57d.**	−·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	612	·12d.	695	**·11d.**	−·01d.
Works costs	£7,689	1·49d.	£9,866	**1·58d.**	+·09d.
Rent, rates and taxes ..	1,498	·29d.	1,833	**·30d.**	+·01d.
Management expenses, directors' remuneration, salaries of secretary, collectors, clerks, & audit fees	2,071	·40d.	2,179	**·35d.**	−·05d.
General establishment charges, stationery and printing, law charges and insurance.	756	·15d.	820	**·13d.**	−·02d.
Other expenses: Trustees' remuneration, &c.	222	·04d.	103	**·02d.**	−·02d.
Total cost ...	£12,236	2·37d.	£14,801	**2·38d.**	+·01d.

In the profit statement we show a balance of £5,799. This has been utilised to provide further payments of dividend amounting to £5,541, and the balance of £258 has been added to the balance from 1899, and carried forward to this year's account. The renewals account is practically a suspense account. The dividend paid represented 6 per cent. for the year 1900.

PROFIT STATEMENT.

	1899.	1900.
Interest on debentures	£2,250	£2,250
Net profit carried to dividends	4,558	4,558
" " depreciation account	4,500	6,000
" " renewal fund	2,500	3,000
" balance	5,610	5,799
Gross profit	£19,418	£21,607

CITY NOTES.

Indo-European Telegraph Company.

MR. J. H. TRITTON presided at the meeting of this company held at the offices on Tuesday, and in moving the adoption of the report, said that they were aware that there had been a strong agitation in this country and in India for a reduction in the rate to India. At the last meeting he informed them that the company would not stand in the way of a reduction, and he had now to inform them that the directors had, both in England and abroad, actively advocated a reduction, recognising the anomaly of lower rates to Australia than to India, the Australian rate now being 3s. 6d., while the Indian rate remains at 4s. The reduction in the Australian rate had had a fairly satisfactory result, and he trusted that they might expect the same of the reduction of the Indian rates if and when it takes place. A measure of that nature could not, however, be introduced without other interested administrations being in accord. Nearly all administrations were adherents to the International Telegraph Convention, but the arrangements did not always work as well as they could wish, hence the delay. If the Conference, which was to have been held in May this year, had not been postponed until next year, this question, like many others of a similar pressing nature, might have been settled with less trouble, delay, and labour for all concerned. This company was still in negotiation with the German Government for the extension of the German concession. The board were sorry that this had not been already granted, but important questions of this sort often necessitated prolonged negotiations, more especially when their negotiations in their turn were dependent upon other international questions with which the company was in no way connected. The board were about to give evidence, in common with other telegraph companies, before the Cable Communications Committee. They were glad that the public would shortly be supplied, through the report of the Committee, with full and accurate information concerning telegraph companies which had done so much for the commercial welfare of the Empire, and which had been persistently attacked both in the press and elsewhere by gentlemen who did not appear, always at any rate, to have been in possession of the facts. As shareholders were aware, the company always endeavoured to keep abreast of the times, and with the increased traffic passing over their lines, it was necessary to get messages through with the greatest possible speed. They were now trying new apparatus for punching messages automatically, and the rate of the punching was more than twice that of the older instrument, and they hoped that the speed over the line would be increased. Experiments had been made with the Wheatstone transmitter at a speed of 100 to 80 words per minute over distances of 3,400 miles, a result which showed the very satisfactory condition

of their line; although that speed might not be obtained in practical working, it was necessarily a first rate result. Turning to the financial side of the business, they found that there had been a larger balance of profit than for the preceding year by about £9,000. This was accounted for in part by the increased receipts derived from the Indian, trans-Indian, and South Russian messages. In the profit and loss account there was a credit of £17,000 under the heading "Persian Government repayment." This was a somewhat unexpected windfall during the year, and it was utilised in providing to the extent of £15,000 for depreciation in investments. For the first time in the history of the company the investments showed in the aggregate a slight loss, but this was fully covered by the £15,000. Expenditure was somewhat higher, owing to additional remuneration to staff on account of increased traffic, and there were slight increases in other items. Since the close of the year £50,000 had been invested from the cash balances in British Government securities.

Mr. HOLLAND seconded the adoption of the report, which was carried.

The retiring directors and auditors were re-elected.

The Western Telegraph Company, Limited.

THE directors' report for the half-year ended December 31st, 1900, reads:—

"The revenue for this period amounted to £264,717 8s. 8d. and the working expenses to £84,139 10s. 1d. After providing £10,291 10s. 10d. for debenture interest and sinking fund, and £6,361 3s. 4d. for income-tax, there remains a balance of £163,925 4s. 5d.; to this is added the sum of £8,571 0s. 8d. brought forward from June 30th last, making a total of £172,496 5s. 1d. First and second interim dividends, amounting to £62,379 have been paid, and after transferring £100,000 to the general reserve fund and £2,000 to a reserve fund for maintenance ships, there remains a balance of £7,689 0s. 1d. which is carried forward to the next account. The revenue includes £11,888 1s. 6d. dividends upon the company's investments in other telegraph companies. The directors feel much regret on reporting the death of their valued manager, Mr. W. H. Axworthy, who had been connected with the company from its inception, and had continued over many years to render very valuable services. The directors will bring forward a proposition for a grant to his widow. The laying of the additional cable between Rio de Janeiro and Montevideo, referred to in the last report, was successfully accomplished on December 8th last. In consequence of the lamented death of her late Majesty Queen Victoria, the quinquennial International Telegraph Conference which had been arranged to be held in London in May has been postponed until next year. The cable steamer *Norseman* has recently returned to her station in Brazil after undergoing considerable alterations and repairs, which it is expected will improve her efficiency and reduce the cost of working. The company has acquired an interest in Electra House, Limited, a company formed by the Associated Telegraph Companies to erect and manage a building to provide offices in London for submarine cable companies and others. The premises are in course of erection, and it is expected will be ready for our occupation in March next year. The tariffs for correspondence with South America have recently been reduced by the company."

West Coast of America Telegraph Company, Limited.

THE report for 1900 to be presented at the meeting on the 7th inst. states that the gross income was £30,888, as against £28,347 in 1899, and the working expenses £23,046, as against £21,065. After providing for the interest on the 4 per cent. debentures and the interest on the 4 per cent. income bonds, the net balance of profit was £1,042, and adding £256 brought forward, there remains an amount of £1,298, out of which the directors have appropriated £710 for the balance of the expenses of reconstruction, leaving £588 to be carried forward. The improvement in trade on the West Coast was maintained, and the rate of exchange at Valparaiso on London shows a further rise. The cables, landlines and the repairing steamer have been kept in a state of efficiency.

Elmore's German and Austro-Hungarian Metal Company.

MR. JOHN MCFARLAN presided at the annual meeting held on Monday at Winchester House. In moving the adoption of the report, he said that the company in Germany had settled down to steady-going business, and although the final result might not be as good as they naturally wished, it was considerably better than for the year 1899. The trading profit of the "Metall" Company of M. 448,522.00, as compared with M. 364,190.00 of the previous year, showed that there was a considerable increase in the work done during the year. In 1899 they suffered considerably by the extraordinary rise in copper, owing to contracts they had in hand. Last year, when copper was fairly steady, they anticipated a good result, and although it proved to be fairly satisfactory, had it not been for the great increase in the price of coal and in the cost of labour, that result would have been more satisfactory still. The present year promised to be normal as regards copper, coal, and wages. Their coal contracts showed a very marked reduction in price, copper so far during the year had not fluctuated to any very great degree, and owing to the slackening of trade, wages were more likely to fall than to increase. The "Metall" Company is now recognised as one of the most important tube producers in Germany, and wherever the tubes were used, they had given complete satisfaction. This was an important point, for it was very difficult a few years ago to get the trade even to try them. The factory was now fully occupied, although trade in Germany is not considered good. The board were perfectly satisfied with the result of the company's exhibit at Paris. They had a good show which thoroughly earned the gold medal it was awarded, and from the letters received from all parts of the world, they might be satisfied that the money was well spent. The directors have just visited the works which they have never found in such an efficient state before. Every department is now complete in itself, and the men have room to work without interfering with one another. The result was due to the policy of carrying out extensions initiated by the manager of the works, and the managing director, and rendered possible by the provision of funds by the share and debenture holders. But while the works were quite suitable as far as they went, the company was not at the end of capital outlay, which, if the business was to extend, they must face. They had a large field open to them, and for them to stand still was to go back. The extensions necessary are in order of urgency as follows:—

1. A water jacket blast furnace to smelt slag of which we have a considerable quantity on the ground, and shall make continually more as our output increases. The existing furnace is wasteful and worn out.
2. A railway siding into the works. This will lead to considerable economy. The manager has taken infinite trouble over this project, and all the details are at last settled. He informs us that any long delay in carrying out this work after his negotiations with the Government (who you know own and work the railways) will have a bad effect on the credit of the company.
3. It is also a matter of necessity that there should be ample funds for the purchase of raw copper and stores.

The problem before the board was how to raise this amount. They suggested the conversion of the present £75,000 of 8 per cent. debenture stock into £100,000 6 per cent. debenture stock, redeemable, say, in 20 years. They purposed making this issue a public issue in order that they could go to the Stock Exchange and ask for an official quotation, for it was undoubtedly one of the drawbacks of the stock that there was no free market in it. The balance-sheet showed that copper and stores were valued at no less than M. 999,560.00, or, in round figures, £50,000, and sundry debtors amounted to M. 353,020.00, or, say, £17,600, therefore the debentures would have, over and above their security, an asset of about £37,000, in addition to the factory, the land, the extremely valuable water-power, plant and machinery, and goodwill, to cover the £100,000 debenture stock. They would also have a first charge over the patents in Austria and Hungary. 8 per cent. was an excessive amount for them to pay with such a security, and it was incompatible with their duty as directors to allow this payment to run on longer than could possibly be helped, and they asked the support of both share and debenture holders in carrying out the conversion. If they did not receive a fair amount of support, the directors would have to consider the question of going outside the company in order to place the stock. Shareholders would be advised by circular in due course. They have no fear as to the future. They were doing good business at good prices, and certainly could not see why they should not continue to do so, and continue to progress as they had progressed in the past. The board felt proud that this company should be the first of all the Elmore companies to pay a dividend from profits earned by the working of the process to its original shareholders. It was a great pleasure to them to pay even the small dividend of 1¼ per cent., and there was every reason to believe that at no distant period an improvement may be expected on that figure.

The adoption of the report was seconded by Mr. JOHN HEAL.

The meeting was then addressed at considerable length by Mr. J. H. DUNCAN with reference to a circular which had been sent out by himself and the Marquis d'Hautpoul as representing the English Electro-Metallurgical Company, and to a circular issued by the board in reply. He proceeded to deal with what he termed misleading statements in the directors' circular, and detailed offers of financial assistance which he had brought before them at different times. He advocated the appointment of a committee of shareholders to confer with the directors on the question whether capital could be raised in shares somehow or other, so as to prevent the heavy load of debentures hanging over it, an industrial company, like a sword of Damocles.

The CHAIRMAN said that if any of the statements in their circular reflecting upon Mr. Duncan were erroneous, they apologised for them.

The report and accounts having been adopted, the CHAIRMAN moved the declaration of a dividend of 5 per cent. on the preference shares, and 1¼ per cent. on the 62,911 ordinary shares.

Mr. GARNETT seconded.

Mr. DUNCAN asked whether the directors thought they would be able to carry their 6 per cent. proposal through, as, unless they could do so, it seemed a pity to take several thousands of pounds out of the company to pay these dividends.

The CHAIRMAN said that they had every reason to believe that they would carry it through. The motion was then carried.

The CHAIRMAN then proposed the following resolution:—

That the borrowing powers of the directors be increased so that, in addition to the amount of any temporary loan or overdraft not exceeding £5,000 from the company's bankers, they may borrow £100,000 by the issue of debentures or debenture stock bearing interest at such rate, and repayable at such premium not exceeding 10 per cent., for such term and upon such conditions as the directors may think fit, which issue, or the proceeds thereof, shall be used, in the first place, for the purpose of exchange for, or payment off of, the existing issue of £75,000 of 8 per cent. debenture stock.

This was seconded by Mr. HARRY ELLIS.

Mr. DUNCAN, in a further speech, moved an amendment that the resolution be not put to-day, but that the meeting be adjourned for

a month; a shareholders' committee to be appointed to consult with the board with regard to their proposition as to borrowing powers.

This having been seconded by the Marquis d'Hautpoul, was put to the meeting and lost, the original motion being passed by a large majority.

Mr. Garnett was re-elected a director, Messrs. Cooper Bros. and Co. were re-elected auditors, and a vote of thanks to the chairman closed the meeting.

Calcutta Electric Supply Corporation.

The directors' report to be presented at the annual meeting to be held at Cannon Street Hotel, on Wednesday, May 8th, at 2 o'clock p.m., reads as follows:—"The directors have pleasure in submitting herewith the annual statement of accounts and balance-sheet for the year ended December 31st, 1900, made out in the form prescribed by the Board of Trade and generally adopted by electric supply companies in this country. The capital expenditure, which at the end of the year under review amounted to £118,266, includes a sum of £4,330 for the purchase of a site for the new generating station in the Alipore district. The license for the Alipore district was officially gazetted on September 12th last. The designs for the station are prepared, part of the necessary plant ordered, and a large supply of material for mains shipped to Calcutta. The number of units of electrical energy sold during the year were 199,829 for lighting, and 213,121 for power (total 412,950 units), and the gross revenue from all sources amounted to £11,147 15s. 8d. The working costs were £5,752 17s. 4d., so that the result of the year's operations was a net profit of £5,394 18s. 4d. Exchange is calculated at 1s. 4d. per rupee. To this sum must be added £651 15s. 9d. the balance from last year, and £306 4s. 4d. amount of interest on deposits at bankers, making together £6,352 18s. 5d., less the interim dividend £1,436 9s. 10d., leaving a balance of £4,916 18s. 7d. available for distribution. The directors proposed to place £2,500 to the credit of depreciation account, to pay a final dividend at the rate of 4 per cent. per annum on the paid-up share capital, making with the interim dividend 3½ per cent. for the year, and to carry the balance £327 7s. 9d. forward. During the past year the board have issued 10,000 additional shares at a price of £5 10s. per share, the premium on the issue, £5,000, being placed to reserve fund. During the year 1900 there were 294 houses connected to the mains, the total number of houses on the system at December 31st being 409, the equivalent connections in 8-c.p. lamps amounting to 28,748, an increase during the year of 19,285 lamps. During the year the running of the station has been good. In September last abnormal rains were experienced in Calcutta, over 40 in. having been registered in a single week. As a result several weak places developed in the underground mains, but by the exertions and skill of the company's engineering staff, the difficulties were surmounted with but little interruption in the supply. The popularity of the electric ceiling fans continues to increase, and it is anticipated that a very large number will be in operation in Calcutta before the close of the present year. There is every indication that the current year will be prosperous, as numerous applications from customers are received by each weekly mail. The directors have appointed Mr. James George Henry Glass, C.I.E., late chief engineer and secretary Public Works Department in Calcutta, to be a member of the board, to fill the vacancy caused by the death of Mr. Harrison Hayter. In accordance with the articles of association, Sir Guilford L. Molesworth retires by rotation from the board of directors, and being eligible, offers himself for re-election. The auditors in London, Messrs. J. H. Duncan & Co., chartered accountants, and in Calcutta Messrs. Lovelock & Lewis, chartered accountants, also offer themselves for re-election."

Callender's Cable and Construction Company.

The directors announce the result of work for 1900 as showing a credit balance of £70,547, with £8,222 brought forward, making together £78,768, from which the directors write off for depreciation £7,246, and, to machinery renewal fund £3,000, and after paying interest on debentures and preference dividend there is left net available £56,972. It is proposed to place to reserve, thus bringing up this fund to £100,000, £23,616, to pay the usual dividend on the ordinary shares of 10 per cent., and bonus of 5 per cent., making 15 per cent. in all for the year, part of which has already been paid as interim dividend, leaving to be carried forward £10,856.

Salisbury Electric Light and Supply Company.

The fifth annual general meeting of this company was held on April 23rd. The report stated that the progress made by the company during the past year had been satisfactory. The numbers of consumers had increased from 148, with 6,228 lamps connected, to 210 with 9,795 lamps connected, whilst the sales had increased from £1,165 to £2,320. The profits on the year's working amounted to £1,568 10s. 4d., and after working off the debit balance from last year of £206 7s. 9d., and payment of £1,230 19s. 6d. interest on debentures and loans, there remained a balance of £131 3s. 11d., available for dividend on the ordinary shares. The directors recommend a dividend at the rate of 3 per cent. per annum on the ordinary shares, carrying forward a balance of £21 10s. 1d. to the next account. The report was adopted, and the retiring director (W. M. Hammick) was unanimously re-elected.

Calcutta Tramways Company.

Mr. E. C. Morgan presided at the meeting of this company, held at Cannon Street Hotel, on 25th ult. He said that at the meeting last year he informed the shareholders that a contract for the electrical equipment had been concluded, but that they would themselves have to erect the power house and the necessary sheds for the storage of the cars. For this purpose three valuable plots of freehold land had been purchased. The contractors had also been active in the prosecution of their work, which was proceedimg rapidly. They had to thank the Government Telegraph Department and the Telephone Company for the manner in which they had been met on all matters where there had been a question of telegraphic or telephonic disturbance, and the arrangements which had been made would, he hoped, avoid any possible friction with those important corporations, and obviate all delays which might occur in the solving of any question as to interference. He had also to acknowledge the fair spirit which had characterised the dealings of the Municipality and the Government of Bengal with the requests which from time to time had been made to them on the part of the company in connection with alterations rendered necessary by the new system.

St. James's and Pall Mall Electric Light Company.

An extraordinary general meeting of this company will be held at Carnaby Street, on Monday, May 6th, at 3 o'clock p.m., when the subjoined resolution will be proposed:—

That sub-section "j" of clause 3 of the memorandum of association of the company be altered by the addition after the word "companies" in lines five and six thereof of the words "or guarantee the repayment of the principal moneys and interest secured by the debentures, mortgages, stocks or obligations of any such companies," and that the objects of the company be extended accordingly, and that the directors be author sed to apply to the Court to confirm this resolution under the Companies' Memorandum of Assoc'ation Act, 1890.

Accompanying the above notice, shareholders have received another circular which reads as follows:—

I am desired by the directors to send you the enclosed notice of an extraordinary general meeting to authorise an alteration in the memorandum of association of the company. At the present time the memorandum of the company authorises the directors, amongst other things, to promote and form, or to assist in promoting and forming, any companies or associations for or in connection with any of the purposes of the company, and to issue or guarantee the issue of, or the payment of interest on the shares, debentures, mortgages, stocks or obligations of any such companies, and to take, hold and dispose of any shares or securities thereof. It will be seen that this authorises the company to guarantee the issue of debentures, &c., of another company, or the payment of interest upon such debentures, &c., but does not authorise a guarantee of the principal secured by such debentures, &c. The Central Electric Supply Company, Limited, which has been authorised by Act of Parliament to erect works for the supply of electricity to the St. James's and Westminster Companies, will require to raise money on debentures or mortgage for the construction of the generating station at Grove Road, St. John's Wood. In order to raise these moneys on the best terms possible, it is desirable that a guarantee for both principal and interest should be given jointly bythe St. James's and Pall Mall Electric Light Company, Limited, and the Westminster Electric Supply Corporation, Limited. The Westminster Company has power by its memorandum to give such a guarantee, but it is not clear that the memorandum, to which reference has been made, gives such power to the St. James's Company. It is to give this power that the meeting is summoned. A special resolution will have to be passed—that is to say, a resolution passed at one meeting, and confirmed at a second meeting. The resolution will then have to be approved by the Court of Chancery upon a petition to be presented by the company.

Cuba Submarine Telegraph Company.

The directors' report for the half-year ending December 31st, 1900, to be presented at the meeting to be held on May 8th, reads as follows:—

The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended December 31st last. From these it will be seen that the total receipts (including the balance of £5,204 15s. 4d. brought from last account) amount to £16,175 6s. 2d., and the gross expenditure to £5,502 17s., leaving a sum of £10,672 9s. 2d. to be dealt with. The dividend on the preference shares will absorb £3,000, and leave £7,672 9s. 2d., out of which the directors recommend the payment of a dividend at the rate of 4 per cent. per annum on the ordinary shares, free of income-tax, the balance, £4,472 9s. 2d., being carried forward to the current half-year. The cables have continued in good working order throughout the half-year. The negotiations between the Foreign Office and the Government of the United States, referred to in last report, regarding the payment of the subsidy of £2,000 per annum in arrear since January, 1899, and the claim for damages done to the cables during the Spanish-American war, still continue. The directors regret the delay in the settlement of these questions.

Oriental Telephone and Electric Company.

Sir A. Colville presided at the annual meeting held at Cannon Street Hotel last Friday, and in moving the adoption of the report, which has already appeared in our columns, said that at last year's meeting the directors held out anticipations of increased dividend; circumstances went well with them, and their anticipations had been fulfilled, they having proposed an additional 1 per cent. The surplus remaining at the end of the year was rather more than in a previous year. Instead of again placing £3,000 to the new reserve fund, they proposed that only £2,000 be invested, and a larger sum carried forward, namely, £2,700 against £1,500 last year. The reason for this was that the capital requirements of the company, both for the electrical branch and the telephone construction branch at the different centres, necessitated the employment of all available funds. In the accounts appeared an item of £3,890 temporary advances on £4,000 consols. Those belonged to the capital

reserve fund, not to the new general reserve fund, and should have been sold when funds were required, but as a great fall took place in consols, they decided to raise a temporary loan instead of selling them. In Egypt the placing of telephone wires underground is to be completed so as to be ready for the business season in October. Mr. Grëwing, jun., was making a tour of all their important companies in eastern seas, including the Straits, India, and Burmah, and was personally acquainting himself with the requirements of the different centres and the staff. As to the outlook, with ordinary caution they ought to do as well this year as last. In reply to a shareholder who asked whether the electrical agency business was sufficiently profitable to warrant its continuance, the chairman said that that matter should be prudently left with the directors to decide. There was very considerable competition, and it was not desirable that they should show in the accounts or make more public than they could avoid, the amount of the profit or loss. If the directors thought it undesirable to go on, they would fall in with the suggestion to drop it.

The report was adopted, and the resolutions declaring dividend and re-electing directors and auditors were also carried, two shareholders expressing the opinion that £1,400 was rather a large sum for directors' fees. The solicitor explained that by the articles they were entitled to draw £1,500.

Imperial Tramways Company.—This company has been raising further capital for the purpose of paying up its investments in the London United Electric Tramways. Holders of the debenture stock, preference shares, and ordinary shares of the Imperial Tramways Company have been offered the opportunity of making application for a further issue of 10,000 Imperial 6 per cent. cumulative preference shares of £10 each, ranking *pari passu* with the existing preference shares. The issue price is £12 10s. per share. Applications had to be lodged with the company's bankers, the Bank of England, Bristol, by May 1st.

Stock Exchange Notices.—Applications have been made to appoint a special settling day in and to grant a quotation to—Charing Cross and Strand Electricity Supply Corporation, Limited—Provisional certificates for £250,000 4 per cent. debenture stock. The Committee has also been asked to allow the following securities to be quoted in the Official List:—Bournemouth and Poole Electricity Supply Company, Limited.—Further issue of 1,500 ordinary shares of £10 each, fully paid, Nos. 6,001 to 7,500; and 1,500 cumulative preference shares of £1 each, fully paid, Nos. 13,601 to 15,000.

Submarine Cables Trust.—The report for the year to April 15th states that the revenue, including £74 brought forward, amounted to £24,976. The expenses amounted to £1,383 and the payment of the coupons to £20,061, leaving a balance of £3,532, out of which the sum of £3,487 has been transferred to the redemption fund, leaving a balance of £44 to be carried forward.

Prospectus.—The list of applications was open until Wednesday for an issue of 6,400 non-cumulative 5 per cent. preference shares of £10 each in the British Columbia Electric Railway Company, Limited. The necessity for raising new capital was explained at the recent meeting of the company.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending April 26th were £552; corresponding week last year, £457; increase, £95. Total to date, £7,291; corresponding period last year, £6,582; increase, £702. Miles open, 8½.

Blackpool and Fleetwood Tramways.—The receipts for the week ending April 27th were £347; corresponding week last year, £394; decrease, £47. Total to date, £3,590; corresponding period last year, £3,919; decrease, £329.

Bristol Tramways and Carriage Company.—The receipts for the week ending April 26th were £4,644; corresponding period last year, £3,021; increase, £1,627.

Central London Railway.—The receipts for the week ending April 27th, were £6,611; previous week, £6,443; increase, £168. Total receipts to date (17 weeks), £104,595. Miles open, 6.

City and South London Railway.—The receipts for the week ending April 28th were £1,811; corresponding week last year, £1,274; increase, (Moorgate extension open) £567. Total to date, £33,861; corresponding period last year, £20,963; increase, £12,898. Miles open, 1901, 4½; 1900, 3½.

Dover Corporation Tramways.—The receipts for the week ending April 27th were £203 4s. 10d.; corresponding week last year, £166 12s. 6d.; increase, £36 12s. 4d. Total to date, £2,871 5s. 5½d.; corresponding period last year, £2,653 13s. 5½d.; increase, £217 12s. 0d. Miles of track open, 3; Car miles run, 1901, 5,063; 1900, 4,991. Number of cars, 1901, 11; 1900, 11.

Dublin United Tramways Company.—The receipts for the week ending April 26th were as follows:—D. U. T. Co., electric cars, £3,613 5s. 7d.; D. S. D. Co., electric cars, £856 15s. 11d.; total £4,470 1s. 6d.; corresponding week last year—D. U. T. Co., electric cars, £4,079 0s. 8d.; ditto, horse cars, £60 18s. 5d.; D. S. D. Co., electric cars, £1,176 2s. 9d.; total, £5,315 1s. 10d.; decrease, £845 0s. 4d.; aggregate to date, £65,046 6s. 7d.; aggregate to date last year, £67,052 4s. 1d.; decrease, £2,005 17s. 6d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses. for the corresponding period last year. (Review in Phœnix Park and Queen's visit, 1900.)

Liverpool Overhead Railway.—The receipts for the week ending April 28th were £1,591; corresponding week last year, £1,433; increase, £158. Total to date, £25,919; corresponding period last year, £23,903; increase, £2,016. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

THE customary May-Day holiday on the Stock Exchange was quite sufficient excuse for many members to absent themselves altogether for the first part of the week. Business in the investment departments is, therefore, comparatively inactive. With the price of Consols standing below 94½, there is still no inducement for the capitalist to buy gilt-edged securities returning between 3 and 4 per cent. on the money. But with the new loan comfortably floated, and with the certainty that the Government cannot come upon the market for more supplies of cash at present, the position stands every chance of improvement, and it should not be long before investment markets receive that proper share of public attention which has been denied to them for so long.

Speculation is all but rampant in the Stock Exchange, and the wild fever engendered by the boom in American rails has caught Anglo-American Telegraph stocks in its train. The rise in these forms the principal feature of the week. Both Ordinary and Preferred are points better, but the main excitement is concentrated upon the Deferred stock. A week ago it stood at 8½, and the market had a sickly look about it even at that price. Since then the price has been up to 11⅛, relapsing to the fractionless figure. German competition is forgotten for the time being, and rumours are circulating to the effect that America is buying the stocks; a very unlikely story. Commercial Cable and Submarine Cables Trust have hardly been mentioned during the week, but some attention has been turned to Direct United States, which caused the shares to change hands freely about 10. The par value, it is worth remembering, is £20 per share fully paid.

As regards the Far East quotations, Eastern Ordinary stock hangs fire, the price having drooped below 140. At this stage it is generally pretty safe to buy the stock. Eastern Extensions are now quoted *ex* dividend and bonus, and making allowance for this, the price has sympathetically slipped back with Eastern Ordinary. Western Telegraph descriptions are unchanged on the appearance of the report, which tells of a profit of £163,925 for the half-year ending with the last century.

In the electrical supply market the sharp advance in Metropolitans claims first notice. The recent fluctuations in these shares are especially interesting, as illustrating what may happen to other electric lighting shares should the local authorities obtain Parliamentary powers for competition with existing companies. It was not so long ago that Metropolitans were standing at 17. From that they fell to 10½ on fears that Parliament would confirm the Board of Trade Order granted to the Marylebone District Council. The Bill has now been temporarily withdrawn, and we understand that fresh negotiations have been opened up for the purchase of the undertaking by the Marylebone authorities. Whoever it is that has been purchasing Metropolitans this week, the market attributes the buying to people who seemed to have early information about the withdrawal of the Bill.

Charing Cross Debentures are 2 premium, and British Insulated Wire new stock is 3 premium. London Electric Preferences are decidedly harder, having been bought on the meeting. The unsatisfactory report was fully explained at that function, and those who, in the words of a Stock Exchange shareholder, "went to throw bricks at the Board," left the meeting as happy as April lambs. Edmundsons are hard, and the tone amongst the higher-priced Supply shares is good all round.

Central London shares are strong on the continued prosperity of the line as evidenced by its traffic receipts, and on the success which has attended the opening of the new electric tramlines in the West of London. There seems to be no reason why the shares should not gradually advance to over par, as they did last year. City and South London stock has enjoyed a little vogue, and the Ordinary is now 50 once more. It is thought that the cricket season will help the company largely, as heretofore, and cricket is on the verge of beginning. Waterloo and City is unchanged. Great Northern and City Preferred "A" are £9 *ex* a dividend of 2s. 9½d. per share.

British Electric Tractions are quiet. Mr. Pierpont Morgan has perhaps got his hands too full of ships to trouble about traction enterprise at the moment. British Columbia Electric Railway new Preferences are hardly marketable, being very much the same as the existing shares, quoted at 10¼. The Ordinary are 7, and the 4½ per cent. first mortgage Debentures 99 per cent. for the £40 bonds. Some few bargains are being done in Merthyr Electric Traction and Lighting shares, but some shyness has been shown in making a market because of the fact that a Debenture issue is shortly to be placed in front of the Preferences now offered.

Owing to the Callender's dividend not being raised, the price of the shares was slightly lowered. Still, 15 per cent. for the year cannot be called bad by any means, and at the current quotation the yield is exactly 5 per cent. to a buyer. Other manufacturing shares are uninteresting. There has been no further fall in National Telephone Ordinary.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotations April 24th.	Closing Quotation May 1st.	Business done during week ended May 1st, 1901. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —102	99 —102	99	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	55 — 65	55 — 65	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3½%	50 — 53	53 — 56	55	...
3,088,540£	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	94 — 96	97 — 99	98½	94⅝
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	8¼— 8¾	10⅜— 11⅛	11⅛	8 5/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3¼— 3⅜	3¼— 3⅜	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	100 —102	100 —102	101⅛	101¼
16,000	Cuba Telegraph	10	8 %	7 %	...	7½— 8½	7½— 8½	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	16 — 17	16 — 17	16¼	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 — 104%	100 —104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	9⅜— 10⅛	9⅜— 10⅛	10⅛	9⅞
108,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	137 —142	135 —140	138	135
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	91 — 94	91 — 94	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	113 —117	111 —115xd	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	13½— 14	13⅞	...
50,000	Do. Nos. 250,001 to 300,000 (iss. at £3 pm. all pd.) ...	10	...	...	...	13¾— 14¼	13½— 14xd	...	...
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	99 —102	99 —102	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	5½%	5½%	...	9⅜— 10¼	9⅜— 10¼	9⅛	...
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14⅜— 15½	14⅜— 15½	15	...
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	34 — 35	34 — 36	...	...
82,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	44 — 48	44 — 48	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝— 1	⅝— 1	...	...
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	2¼— 3⅛	2⅜— 3⅛	3	2 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	10½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	10 — 12	10 — 12	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4 — 4½	3⅞— 4¼	4 1/16	3⅞
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	87 — 90	87 — 90	...	...
500,000£	Do. 4 % Deb. Stock Red.	100	...	...	4 %	95 — 98	95 — 98	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅜— 1½	⅜— 1½	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	99 —102	99 —102	...	...
11,839	Reuter's...	8	5 %	5 %	...	7½— 8½	7½— 8½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	120 —125	120 —125	...	...
58,000	United River Plate Telephone	5	6 %	7 %	...	4½— 5	4½— 5	...	...
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅝— 5⅛	4⅝— 5⅛	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	97 —100	97 —100	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	99 —102	99 —102	..	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜— 14⅛	13⅜—14⅛	14⅛	13⅞
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	101 —104	101 —104	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅝— ¾	⅝— ¾	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	6 — 7	6 — 7	6⅛	6⅝
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	5 — 7	5 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅝— 8¼	7⅝— 8¼	...	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½— 9	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5 — 5½	5 — 5½	5⅜	5 5/16
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅜— 6¼	5⅜— 6¼	6¼	6 1/16
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	...	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½— 9½	8½— 9½	9¼	9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12 — 13	12 — 13	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8 — 9	8 — 9xd	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	11 — 12	11 — 12xd	11⅛	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	106 —109	106 —109	...	...
35,500	Edmundson's Elec. Corp., Ord. Shares	5	7 %	...	...	5 — 5½	5 — 5½	5⅜	5¼
13,363	Do. do. 6 % Cum. Pref. ...	...	...	...	...	5¼— 6	5¼— 6	...	...
75,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	103 —106	103 —106	...	...
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	10½— 11½	11 — 12	11 5/16	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	101 — 104	102 —105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1½— 1⅝	1½— 1⅝	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	3½— 4½	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	98 —101	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	10½— 11½	11½— 12½	12¼	10½
220,000	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	110½	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	16	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	13½— 14½	14 — 15	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	...	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	11½— 12½	12 — 13	12⅝	12

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation April 24th.	Closing Quotation May 1st.	Business done week ended May 1st, 1901. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7½ — 8½	7½ — 8½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	91 — 95	89 — 93 xd	...	...
45,000	British Electric Traction	10	6 %	...	...	15 — 16	15 — 16	15⅝	15½
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	11½ — 12½	12 — 13	...	...
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	119 —122	119 —122	121½	120
85,000*l*	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	1/16 — 3/16	1/16 — 3/16	...	...
50,000	† Do do. 6 % Cum.Pref., 1—50,000 ...	...	...	...	...	3/16 — 5/16	3/16 — 5/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	85 — 90	85 — 90	...	...
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	10 — 11	10 — 11	10 9/16	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞xd	1¾	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2 — 2¼	2 — 2¼xd	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —103	101 —103	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	15 — 16	14½ — 15½	15½	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5⅞	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9 — 9⅛	9¼ — 9⅜	9⅝	9⅜
78,703	Do. do. Pref. half-shares	5	...	...	...	4⅝ — 5¼	4⅝ — 5¼	5	4 1/16
78,703	Do. do. Def. do.	5	...	...	...	4¼ — 4⅝	4⅛ — 5	...	...
855,000	City and South London Railway	Stock	2⅛%	1⅞%	1½%	46 — 50	50 — 53	...	...
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	4 — 5	5 — 5½	...	...
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½%	...	3½ — 4	3½ — 4	...	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	100 —103	101 —104	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1½ — 2	1½ — 2	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	3 — 4	3 — 4	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	87 — 89	...	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅞ — 2¼	1⅞ — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2⅞ — 3¼	2 1/16	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 11	10 — 11	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15 — 16	15 — 16	15 1/16	15½
35,000	Do. do. do. 4½ % Pref.	5	...	4½%	4½%	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	...	...
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3¼%	3¼%	3¼%	7 15/16 — 8 1/16	7 15/16 — 8 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	13 — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½%	36 — 40	36 — 40	36	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	101 —104	101 —104	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	...	10½ — 11½	10½ — 11½	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	94 — 97	94 — 97	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 3/—4/-
National Electric Free Wiring, 12/6 paid, 3/16—11/16.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 16—17.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (February 21st, 1901).

MARKET QUOTATIONS, Wednesday, May 1st.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	52/-	52/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	59/-	59/-	..
a Ammonia, Muriate (crystal) .. per ton	£33 10	£33 10	..
a ,, ,, .. per ton	£30	£30	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£17 10	£17 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90%) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£24	£24	..
a ,, White Sugar .. .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. .. per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C). per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a ,, Caustic (75/80%) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	64/-	64/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6 5s.	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a ,, Crystals .. .. .. per ton	£3	£3	..
,, Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots.. per ton	£224	£224	..
b ,, Sheet, in ton lots per ton	£191	£191	..
p Babbitt's metal ingots.. .. per ton	£75 to £180	£75 to £180	..
c Brass (rolled metal 2" to 12") basis per lb.	7½d.	7½d.	..
c ,, Tube (brazed) .. .. per lb.	10d.	10d.	..
c ,, ,, (solid drawn) .. per lb.	8½d.	8½d.	..
c ,, Wire, basis .. .. per lb.	8d.	8d.	..
c Copper Tubes (brazed) .. per lb.	11d.	11d.	..
c ,, ,, (solid drawn) .. per lb.	10½d.	10½d.	..
g Copper Bars (best selected) .. per ton	£85	£85	..

METALS, &c. *(continued.)*	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£85	£85	..
g ,, Rod .. .. per ton	£85	£85	..
e ,, (Electrolytic) Bars .. per ton	£82	£82	..
,, ,, Sheets .. per ton	£90	£90	..
e ,, ,, Rod .. per ton	£84	£84	..
e ,, ,, H.C. Wire per lb.	9¾d.	9¾d.	..
f Ebonite Rod .. .. per lb.	3/-	3/-	..
f ,, Sheet .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. .. per lb.	1/5	1/5	..
h Gutta-percha fine .. .. .. per lb.	8/-	8/-	..
h India-rubber, Para fine .. .. per lb.	3/9½ to 3/10	3/11	dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) .. per ton	45/6	45/4½	1½d. inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. .. per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 .. per ton	£10 5	£10	5s. inc.
g Lead, English Ingot .. .. per ton	£12 5 to £12 11 3	£12 10s. to £12 15	dec.
g ,, ,, Sheet .. .. per ton	£15	£15	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bot.	£9 2 6	£9 2 6	..
d Mica (in original cases), small .. per lb.	8d. to 9d.	8d. to 9d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large .. per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. per oz.	£4	£4	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/0½	10½d. to 1/0½	..
i Steel, Magnet, acc'd'ng to desc'p'n per ton	From £15	to £40	..
i ,, ,, in bars	£58	£58	..
g Tin, block .. .. per ton	£121 to £122	£120 to £121	£1 inc.
g ,, foil .. .. per lb.	1/9	1/9	..
n ,, wire, Nos. 1 to 16 .. .. per lb.	1/8	1/8	..
p White Anti-friction Metals — "White Ant" brand .. .. per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's per lb.	8½d.	8½d.	..
j ,, Best Flax, 6 lbs. .. .. per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. .. per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£14 5	£14 5	..
k Zinc, Sh's. (Vielle Montagne ord.) per ton	£21 10	£21	10s. inc.

Quotations supplied by { *a* Messrs. G. Boor & Co. *b* The British Aluminium Co., Ltd. *c* Messrs. Thos. Bolton & Sons. *d* Messrs. F. Wiggins & Sons. *e* Messrs. Frederick Smith & Co.

Quotations supplied by { *f* India-Rubber, G.-P. and Teleg. Works *g* Messrs. James & Shakspeare. [Co., Ltd. *h* Messrs. Jackson & Till. *i* Messrs. Bolling & Lowe. *j* Messrs. Henry C. Yee & Co.

Quotations supplied by { *k* Messrs. Morris Ashby, Limited *m* Messrs. W. T. Glover & Co., Ltd. *n* Messrs. P. Ormiston & Sons. *o* Messrs. Johnson, Matthey & Co., Ltd. *p* The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER SECTION).

The annual general meeting of this Section of the Institution of Electrical Engineers took place at Owens College on Tuesday, April 23rd.

Dr. Hopkinson presided, and there was a large attendance.

The Hon. Sec. read the following report:—

The Manchester Section of the Institution of Electrical Engineers. Report of Committee. First Session, 1900—1901.

The Committee have pleasure in submitting to the members of the Manchester Section of the Institution of Electrical Engineers their first annual report. Seven ordinary general meetings have been held at which communications were received.

The meetings were well attended, there being an average of nearly 100 members and friends present on each occasion. The communications were much appreciated, and gave rise to some interesting discussions.

Some of the papers read would appear in the minutes of *Proceedings* issued from the central office in London. The secretary has in his possession a few copies of papers which will not be printed in the journal, and he would be glad to forward any of these which may be applied for. A volume in duplicate containing all the papers will be bound up and added to the library of the Section where it would be available for reference. The Committee regret that they have not yet been able to make arrangements for a convenient place for the existing library.

Through the courtesy of the editors the following papers have been sent to the secretary:—The *Electrical World*, New York; the *Electrical Review*, New York; *Electricity*, New York; the Electrical Review, London; the *Electrician*, London; the *Electrical Engineer*, London; *Lightning*, London; *Electricity*, London; the *Mechanical Engineer*, London.

The total roll of the Section comprises 280 members approximately, of all sorts.

The committee were approached during the session by the Manchester Society of Junior Electrical Engineers with a view to its members joining the Institution of Electrical Engineers, and it is expected that this arrangement will very shortly be carried out.

It is proposed to print a list of members of the Section, and copies will be sent to all the members.

No accounts are issued, as all expenditure is provided for by the central office in London. The expenditure for the year has been approximately £75, which came to 4s. 5d. or 4s. 6d. per head.

The Committee desire to express their great appreciation of the kindness of the Council of the Owens College and Dr. Schuster, Professor of Physics, for allowing the meetings of the Section to be held in the new physical laboratory of the college. In conclusion, the Committee consider that they may congratulate the members upon a successful session and also upon the promise of the future, as they feel that the existence of the Section has been shown to be fully justified by the interest shown in the proceedings, and they hope that members will contribute as far as possible to the success of the coming session by the offer of papers, by attending the meetings, and taking part in the proceedings.

In moving the adoption of the report, the Chairman said he did not know that there was much to add to the full report which had been presented by the hon. sec., and approved by the Committee. They had not only had instructive matter, but good matter for discussion. They had had gentlemen of the very highest eminence in the profession who had responded to the request of the Committee, and had devoted no small amount of time and trouble to the preparation of the papers. He (the chairman) thought they might agree that the quality of the papers had been invariably equal to that of the papers read before the Institution in London. He thought the Council had recognised that by printing a number of the papers, or if not actually printed, they would be printed in the *Proceedings* of the Institution. He formally moved the adoption of the report.

Mr. J. J. Moss seconded, and the report was adopted.

Mr. H. Lindley asked the members to pass a very hearty vote of thanks to Dr. Hopkinson.

Dr. C. H. Lees said it afforded him very great pleasure to second the proposition Mr. Lindley had made. He was sure that in other ways they might show their appreciation of Dr. Hopkinson's services. They might carry his example to other societies.

The vote was carried with acclamation.

Dr. Hopkinson thanked the members very much for their vote of thanks. It had, he said, been a great pleasure to him to be their chairman and to make any efforts he had been able to make to increase the usefulness and promote the prospects of the Section.

On the proposal of Mr. H. Earle, seconded by Mr. Coates, a very cordial vote of thanks was passed to the hon. secretary and treasurer, Mr. Edward W. Cowan.

Mr. Cowan briefly thanked the members for the vote which they had accorded him.

The following officers were elected for the ensuing session:—Chairman, Mr. C. H. Wordingham; vice-chairman, Mr. H. A. Earle; hon. sec. and treasurer, Mr. E. W. Cowan. For the vacancies on the Committee: Messrs. S. V. Clirehugh, C. M. Dorman, W. P. J. Fawcus, A. H. Gibbings, A. S. Giles, J. S. Highfield, A. Bromley Holmes, H. Lindley, G. F. Metzger, A. B. Mountain, R. C. Quin, and C. D. Taite.

The Chairman then moved that the best thanks of the Section be given to the Council of Owens College, and to Prof. Schuster for the use of the room for the meetings of the Section. He thought that anything which would draw together the theoretical side of research and the more practical side which interested them, would be good for the society and for themselves.

Mr. J. Frith seconded the resolution. As an old student of Owens College, he did so more especially from the debt of gratitude which he owed for his student days there.

The resolution was carried with sustained applause.

The Chairman said that the hon. secretary was to have opened a discussion on "Some Hindrances to the Development of Electrical Engineering in this Country," but since coming there they had found that the chief demonstrator had made a very large provision for their reception, and it seemed best to the Committee not to have the discussion that night on a subject which, if discussed at all, would have to be very fully discussed, more particularly as Mr. Cowan had promised to put his thoughts into better form and read a paper next session on the subject. He hoped the officers would keep Mr. Cowan up to his promise. Dr. Lees had very kindly consented to give them a short description of the laboratory. He would ask him to do so.

Dr. Lees briefly described the various rooms of the new physical laboratories and the principal apparatus in them. At the close of his description he conducted the party through the different rooms, and pointed out the different articles of apparatus, describing the uses of the more important.

The electrical installation and generating plant, of which a full description appeared in the Electrical Review of April 12th, naturally proved of absorbing interest. The electrical furnace was made the subject of a special and lucid description by Dr. Lees.

The electric furnace, Dr. Lees said, gave the highest heating power known. The furnace shown was worked at 1,000 amperes, and they could get a temperature of 3, 4 or 5 thousand degrees Centigrade.

After a careful inspection of the other departments of the laboratory, the members of the Section separated after a most enjoyable gathering.

THE PAN-AMERICAN EXPOSITION.

By ORRIN E. DUNLAP.

One of the remarkable and weird features that will delight the crowds at the Pan-American Exposition will be the grottoes under the Triumphal Bridge. This bridge is near the southern entrance to the Exposition grounds, and is a structure of commanding proportions and surpassing beauty. It is swung from four monumental piers 100 ft. in height, each pier being surmounted by a sculptural group—a muscular youth on the back of a horse 30 ft. in height, which rears above a mass of trophies indicative of feudalism, slavery and subordination to tyrannical power, the whole expressing the triumphant struggle of the people of the United States to free themselves from the institutions of despotic ages. This group is named "The Mounted Standard Bearer." The piers of the bridge were designed by John M. Carrere, chairman of the Pan-American board of architects. Terminating the buttresses to the piers are four groups of trophies, typifying peace and power. These were modelled by Mr. Augustus Bukeman. Cables connecting the piers carry festoons, shields, flags and coats-of-arms of the various Pan-American countries. In niches in the side of the structure are statues symbolical of charity, love, truth, patriotism, liberty, &c. This Triumphal Bridge is easily the most magnificent ornamental bridge ever erected, far surpassing the great Alexander Bridge which was considered the finest structure at the Paris Exposition. On either side of the bridge are fountains composed of groups of rearing horses and figures clustered about a tall pole from which a silken flag floats to the breeze. The fountains on the east side typifies the Atlantic Ocean, while that on the west side represents the Pacific Ocean, the one base uniting the two. The water from these fountains gushes forth from the side of the bridge in a massive waterfall into the Mirror Lakes, passing through the subterranean grottoes which constitute one of the most interesting features of the Exposition.

These grottoes, which are destined to be such an important and attractive feature of the Pan-American Exposition, are modelled after the famous Buttes des Chaumont of Paris, by Mr. Rudolph Ulrich, the landscape architect of the Exposition. The grottoes are formed by two channels, each 400 feet long, passing beneath the bridge. The electric launches of the Exposition canals will pass through the grottoes, the craft passing eastward taking one channel, and the boats going westward the other. The channel from east to west will be illuminated with a pink effect, and that from west to east with a green effect. All lights will be concealed. All surfaces in the one channel will appear in a rich red tint, while in the other the surfaces will be of a deep green.

The effort has been to produce a rocky cave in close imitation of grotto work, and it has been thoroughly successful. Weird effects are produced by means of scraggy tree trunks and limbs, together with old stumps and rocks arranged in unusual forms, some imitating huge branches of coral shape. The roof is adorned with stalactites, while stalagmites of wondrous proportions and form appear here and there. Caverns and recesses lead off in serpentine channels through which the boats will pass. Cascades of great beauty rush out here and there, the water falling over rocks that glisten with a magnificence of colour of great beauty. A seemingly calcareous incrustation covers the top of the cavern. So perfect is it all that one looks about to determine the cause of the formation,

and wonders if it was a grand upheaval of the strata, or water, or both causes combined that wrought a place of such beauty and fascination. The very fact that you are in a cavern carries you in fancy to a trip through the famous mammoth cave of Kentucky, and your being in a boat recalls the trip on Echo River. You long to know if the water contains eyeless fish, and to let your voice awaken the never-to-be-forgotten echo of those wonderful Kentucky depths. There is no walking to be done in this Pan-American grotto, and your mind is comforted with the knowledge that there is no Fat Man's Misery or Corkscrew to pass through. You compare the beautiful illumination of these Pan-American grottoes with the Bengal light effects of Old Kentucky, and you realise what wonders the entrance of electricity to the Mammoth Cave would develop, especially if various features were portrayed in colour. There is just a thought of the beam of a projector being hurled into the Bottomless Pit, and how some of the domes would shine under searchlight!

The effect is perfect, and the scraggy, goblin-like appearance will entertain and satisfy the curiosity of all who see it. The novelty of the creation and the unusual size will command attention, and no person will have seen the Pan-American Exposition who has not gone through the grottoes under the Triumphal Bridge. The passing from daylight to either of the channels will be a novel experience, for the eye will have to become accustomed to the new light in the grotto. A similar effect will be observed at night when the grounds of the Exposition are under the full brilliancy of the thousands of incandescent lamps. When one comes out of the grotto the incandescent lamps will appear to shine with a double brilliancy, so that there will be a double enjoyment to the trip. By day, under glorious sunshine, the grounds and building will appear radiantly beautiful to the eye fresh from the grottoes, while at night the splendour of the incandescent lighting of the buildings and grounds will be greatly intensified.

In the placing of the lights in the grottoes, Henry Ruston, chief of the mechanical and electrical bureau, has been exceedingly careful to carry out the effect intended, and as the light falls on the various weird features and the pretty cascades, it will gratify the hearts of all, for the creation will be truly wonderful.

GERMAN ELECTRICAL FINANCE.

The past year has not been a period in which numerous electrical promotions have been brought before the notice of German investors, although the report of the Deutsche Bank expresses the hope that the opportunity for the profitable investment of capital in electrical manufacturing businesses will become more frequent in the future. As a matter of fact, there were only 15 new issues, which totalled £1,383,500, as compared with 32 issues and £1,729,500 capital in the previous year. The depression which has generally prevailed in trade has not been without its effect upon the electrical engineering industry, with the result that withdrawals or dismissals of a considerable number of workmen have taken place in some works, whilst in others the shifts have been reduced. According to a statement made a few days ago by one of the leading electrical engineering companies, there has recently been a slight improvement in the position, and it is thought that the termination of hostilities in South Africa and the conclusion of peace in China may impart a considerable stimulus to German trade. All eyes are, however, turned to the question of the new commercial treaties, and it is considered that the future condition of the electrical engineering industry will in its most essential features largely depend upon the manner in which the treaties are prepared and negotiated with other countries, especially from the standpoint of the export of German machinery and plant. In the meantime attention may be drawn to a few enterprises which have just published the results of their operations during the past year.

The Union Electricity Company.—The prominent position occupied by the Union Elektrizitäts Gesellschaft, of Berlin, appears to be well maintained when regarded from its comprehensive sphere of activity. In 1896 and 1897 the capital of the company only amounted to £150,000, and in each year a dividend at the rate of 12 per cent. was paid. The following year the capital was increased to £900,000, and the distribution was continued at 12 per cent.; but in 1899 the dividend on the same capital declined to 10 per cent., and it has been decided to adhere to this rate for the past year on share capital, which has been advanced to £1,200,000. In addition to this there is now a mortgage loan in the form of 4½ per cent. bonds, amounting to £500,000. As far as the past year's operations are concerned, it may be mentioned that the gross profits amount to £260,700, as compared with £242,290 in 1899, and the net profits to £139,780, as against £113,950 in the previous year. The sum written off for depreciation is £54,870, or £3,950 less than in 1899. The details on this point are very interesting; they show that 2 per cent. is provided for depreciation of buildings, 20 per cent. for stock, 25 per cent. for tools, 50 per cent. for transmission gear and "utensils," and 100 per cent. (the whole cost) for auxiliary tools, patterns, &c. Of the net profits the sum of £120,000 is devoted to the payment of the 10 per cent. dividend, £7,500 is placed to the special reserve fund, £6,290 is required for the remuneration of the directors, and the balance is carried to the next account. The reserve fund now stands at £121,500, and the special reserve fund at £20,000.

It has been found that the night shifts are unprofitable, and these have therefore been abandoned. The construction of small motors on a large scale is expected to lead to success, owing to the system resulting in a reduction in the cost of production. The Admiralty has ordered motors and apparatus for 22 ships, and similar plant is being provided for six large merchant steamers. During the year electrical installations have been carried out to an increased extent in connection with mining and ironworks, one concern having ordered plant to the extent of 4,000 H.P.; whilst no less than 6,000 H.P. has been, or is being, provided for transport purposes in iron and steel works. As far as the equipment of electric tramways and light electric railways is concerned, the company delivered 1,062 motor cars during 1900, as against 1,112 in the preceding year, and received orders for 920 additional cars. The company's report, in discussing the question of main line working, refers to the success of the Carlsruhe—Ettlingen line and the Central London Railway, and points out that electricity must take the lead on further lines for rapid transit where the service is frequent and the stations situated at short intervals. The company does not directly refer to any decline in trade, but merely mentions that the value of orders at present amounts to £2,250,000, as compared with £3,000,000 a year ago.

The Atlantic Telegraph Company.—The promoters of the Deutsch-Atlantische Telegraphen Gesellschaft have every reason to congratulate themselves and the Telegraph Construction and Maintenance Company, as the contractors, upon the success of the new cable during the short period of its existence. Established in February, 1899, with a capital of £700,000, which was increased to £1,000,000 at the beginning of 1900, the company now has a paid-up capital amounting to £1,050,000 and an authorised issue of £1,400,000. The unissued capital is £200,000, and of this sum the Eastern Telegraph Company and the Western Telegraph Company have the option of subscribing for £142,400 as a result of agreements dealing with the transfer to the Germany company by 1904 of the cable between Borkum and Vigo, or of the shares which are apparently held by these two companies in the Deutsche See Telegraphen Gesellschaft, which owns, or owned, that particular section forming part of the new cable to the United States. The laying of the cable was commenced in May of last year, and the preliminary communication from Borkum *via* Fayal and Canso to New York was opened on July 29th. In the meantime the second section of the cable directly connecting the station at Horta with New York was completed by the Telegraph Construction and Maintenance Company, the total length of the cable from the Coney Island station to Fayal being 2,290 knots. It was found possible to commence working the whole of the cable belonging to the company on September 1st, or one month earlier than the date stipulated in the contract, but two interruptions occurred simultaneously on November 13th. The first was a break in the canal on the Emden-Horta section, and the second in the neighbourhood of the Haak lightship on the Dutch coast. The interruption extended over 27 days, and two similar disturbances have occurred during the present year.

The fact that the operation of the new cable has sensibly affected the earnings of the English cable companies lends additional interest to the result of the German company's service during its short period of activity. The company's revenue comprises £15,351 from interest, as against £11,165 in 1899, and £29,379 from the cable service, which with £7,399 brought forward, makes a total of £52,129 for the year. After deducting £9,739 for working expenses, and £4,762 for repairs to cable, transferring £9,791 to the cable redemption and renewal fund, and writing off £1,746 for depreciation, there remains a net profit of £28,090. Of this sum it is proposed to distribute £20,916 among the shareholders by the payment of a dividend at the rate of 2 per cent., to place £1,035 to the reserve fund and to carry the balance forward. The company is largely interested in the North German Submarine Cable Manufacturing Company (Norddeutsche Seekabelwerke Akt.-Ges.), but as the latter only commenced the production of cables last October, there is no question of any return from that investment for the past year. During the year the capital of the manufacturing company was increased from £100,000 to £200,000, and of this sum the cable company is responsible for £88,000.

Berlin Company for Electrical Enterprises.—The Gesellschaft fur Elektrische Unternehmungen, of Berlin, has experienced a check to its prosperity during the past year. Formed in 1894, the company stands in intimate relations with the Union Electricity Company, the Loewe Company and their financial group, and it acts as a trust and financing enterprise for the electro-technical businesses of the group. The capital in 1897 amounted to £1,500,000, and since then bonds have gradually been issued until they exactly equal the share capital. In 1897 a dividend at the rate of 8½ per cent. was paid; in 1898 and 1899 the distribution was increased to 10 per cent. for each year, but it is only proposed to pay 8 per cent. for the past year. The net profits earned during 1900 amount to £143,740 as compared with £180,390 in the previous year, and £120,000 of the former is required for the payment of the dividend, the balance being absorbed by allocations to reserve funds, the remuneration of the board, and the carry forward to the next account. The list of the company's investments, which would occupy nearly a page of this journal, comprises shares in tramways, lighting undertakings, telephone factories, accumulator and other works both in Germany and other countries, including the British Thomson-Houston Company, Ganz & Co., the Anglo-Argentine Tramways Company, and the Chilian Electric Tramways and Lighting Company. The company's report states that the income from dividends and interest during the year contributed more towards the profits than the disposal of securities, and this is regarded as a confirmation of the caution exercised in the selection of investments during the period of high prosperity which prevailed up to about a year ago.

Loewe & Co.—The fortunate position of Messrs. L. Loewe & Co., of Berlin, which for several years has paid dividends at the rate of

24 per cent. per annum, has in no way diminished, since it is possible to maintain that rate for the past year. Although mainly concerned in the construction of machine tools, the company is also interested in other enterprises, including the Union Electricity Company, and the British Thomson-Houston Company. Since 1896 the capital has remained stationary at £375,000, but the bonds have been increased from £283,000 to £475,000. The net profits realised last year reach a total of £99,030, or £2,360 less than in 1899; this slight diminution is due to the large increase in the working expenses. As compared with the previous year, the amount written off for depreciation is less by £5,450, the proportions being 2 per cent. for sites and buildings, 15 per cent. for stock, 50 per cent. for tools, and the entire cost of patterns and auxilary tools.

THE GRIEVANCES OF POSTAL EMPLOYES.

Important Pronouncement.

On June 28th, 1900, a deputation of M.P.'s waited upon the Marquess of Londonderry at the House of Commons for the purpose of laying before him certain matters in regard to promotion and the demand for a Parliamentary Inquiry into the Postal Service. The deputation consisted of Sir Albert K. Rollit, M.P., Mr. W. C. Steadman, M.P., Mr. Patrick O'Brien, M.P., Mr. A. J. Jacoby, M.P., Mr. T. Bayley, M.P., and Colonel Dalbiac, M.P. After much delay, the Postmaster-General has now issued the following reply to the representations then made:—

"General Post Office, London.

"*April 25th*, 1901.

"Sir,—The Postmaster-General has given very careful consideration to the representations made by yourself and other members of Parliament on June 28th last, when you advocated certain improvements in the pay and conditions of employment of telegraphists.

"Lord Londonderry pointed out at the time, as you will remember, that most of the points brought forward by the deputation had been considered and decided either by the Tweedmouth Committee or by the Duke of Norfolk and Mr. Hanbury subsequently, and that he felt compelled to regard decisions so recently arrived at as not open to reconsideration at the present time. To this view he must still adhere, and he is therefore unable to entertain any applications for a general improvement in the scale of the telegraphists' remuneration, or to assent to the appointment of another committee to inquire into the subject. He desires me also to remind you that, if regard be had to the large additional charge (amounting to more than £500,000 for the current year) which has been imposed on the votes for this department during the last four years in consequence of the adoption of the recommendations of the Tweedmouth Committee, and to the general financial position of the country at the present moment, the opportunity is not a favourable one for proposing further expenditure on salaries which have been so recently revised and improved.

"There is, however, one point among those raised by the deputation to which Lord Londonderry has given special attention, though it is, strictly speaking, covered by the foregoing remarks.

"Several of the speakers complained of the insufficiency of the existing maximum (namely, £160) for the rank and file at the Central Telegraph Office, and it was contended by at least two members that the maximum which was attainable in the ordinary course had been reduced in a manner which constituted a breach of faith with the men. If this could have been established, Lord Londonderry would not, of course, have allowed any finding of the Tweedmouth Committee to stand in the way of a reconsideration of the matter. He is satisfied, however, that there is no ground for any such charge. The class of Overseers and Senior Telegraphists (formerly called Senior Telegraphists), which is immediately above the rank and file, and which rises to a maximum of £190, has always been a distinct class, superior to the general body; and promotion to it has always been dependent on the occurrence of vacancies. The allegation that men were entitled to rise to it as a matter of course, and without waiting for vacancies, was never true at any time; and the conditions under which promotion to it is now obtained are precisely the same as they always have been, namely, good conduct and competence to perform superior duties.

"Lord Londonderry further promised to inquire into the stagnation of promotion said to exist in the telegraph service, and to ascertain for himself what were the facts, and whether any remedy was possible. The inquiries have taken longer than was anticipated, and this fact explains the delay in sending you a definite answer, a delay which the Postmaster-General much regrets.

"In considering this subject it is to be noted that the Tweedmouth Committee gave it as their opinion that the work of an ordinary skilled telegraphist is adequately remunerated by wages of £160 a year in London, and by the maxima of the several scales in force in the provinces (which vary according to the importance of the office), especially when the other advantages of Government service—pension, holidays, medical attendance, &c.—are taken into account. No evidence has been brought forward which, in the Postmaster-General's opinion, shakes the soundness of this conclusion, and he cannot, therefore, consider it to be a legitimate grievance that any telegraph operator does not receive more than the wages mentioned.

"But the view sometimes put forward appears to be that as soon as a man has reached the maximum wages of his class, there should be a superior appointment carrying higher pay to which he may be promoted. This view the Postmaster-General cannot accept. In fixing the number of superior appointments, regard must be had, not to the number of men who desire promotion, or even to the number who are qualified for it, but to the number of superior duties to be performed. The Postmaster-General finds that the ratio of superior to ordinary appointments in the Telegraph Service has certainly not diminished in recent years, and he is satisfied that care is being taken to create superior appointments whenever there are superior duties to be provided for. As you may perhaps remember, a special inquiry was made in 1897, in accordance with the undertaking given by the Duke of Norfolk and Mr. Hanbury, in order to ascertain whether any rectification of the number of the supervising classes was justifiable. This resulted in the creation of additional appointments at a large number of the more important offices, and in appreciably raising the ratio of superior to ordinary situations.

"Since, however, the superior duties are not so numerous as the ordinary duties, it may often happen that a large number of men will be receiving the maximum wages of their class, and that the rate of promotion will vary from time to time even in the case of those who are competent for higher duties. But all are not competent, and at many offices a large proportion of men at the maximum could not properly be promoted, even if there were enough superior appointments created for them all.

"It is, unfortunately, the fact, as pointed out by the deputation, that promotion is more rapid on the postal than on the telegraph side of the service, although the difference is not so great now as it was some years ago. The principal reason is that there are more superior duties on the postal side than on the other. On the other hand, telegraphists receive a considerable number of appointments on the engineering staff, and they also receive increased pay while serving as telegraphists, if in possession of certain technical qualifications. It is, moreover, always open to them to acquire a competent knowledge of postal duties, and so qualify themselves for promotion on either side. But it is found, as a rule, that they are not willing to do this, as they prefer the work on the telegraph side to the more irksome duties of the postal side. In any case, however, those now entering the service under the system of dual training will only have themselves to blame, if they are debarred from promotion because of ignorance of either postal or telegraph duties. There is thus good reason to anticipate a time when the present inequality between the two services as regards promotion, will have disappeared.

"It is Lord Londonderry's earnest desire that every member of the staff of the department, in whatever branch he may be serving, should have an opportunity of rising to any post which he is competent to fill, and he will take care that, as far as practicable, superior posts shall be created whenever it appears that duties of a kind which cannot fairly be expected from the rank and file, have to be performed. But he fears that, even under these circumstances, it will not always be possible to find a post for every deserving officer who may consider himself qualified for promotion.

"I am, Sir,

"Your obedient Servant,

"(Signed) G. H. Murray."

The Postal Telegraph Clerks' Association gave notice of a meeting on the question for yesterday at the Memorial Hall. Sir Albert Rollit, M.P., was to be chairman, and would be supported by Sir Michael Foster, M.P., Mr. Henry Cust, M.P., Mr. Thomas Bayley, M.P., Hon. Claude Hay, M.P., Mr. W. C. Steadman, L.C.C., and others.

CENTRAL STATION ECONOMY.—II.

Wages of Workmen.—The next largest item in the bill in most stations of moderate size is the wages and salaries, and the writer does not believe in cutting down the expenses in this direction by paying poor wages and salaries. To produce successful running at any station, a sufficient staff of competent men is an absolute necessity, and this cannot be obtained unless fair wages are paid. It is a too common practice, for instance, to pay the shift engineers an inadequate salary, with the result that as soon as a man has attained a respectable degree of proficiency, he leaves in order to get better money elsewhere, and the chief engineer is consequently put to a great deal of inconvenience by having to train fresh men, who, in their turn, will also leave as soon as they are beginning to get useful. It certainly does not conduce to economy in running to have the staff continually changing. Very often the shift engineer is paid *less* than the fitter, which is an obviously unfair arrangement, as the shift engineer is (or should be) held responsible for all the plant in the station during his shift, has to take night duty one week out of three, and, as a rule, gets very little time off beyond the bare fortnight's holiday in the summer; whereas, the fitter has practically no responsibility, has no night work, and has every week end off in addition to bank holidays and whatever annual leave he may obtain.

The staff required for a station of an output up to 1,000 KW. will be three shift engineers, who should have had a mechanical as well as an electrical training; two switchmen, one for the day and one for the evening shift; four drivers, one each for the morning and night shifts and two for the evening shift; five firemen, if rather a low class of coal is used; one boiler cleaner, who can also act as coal trimmer; one fitter, one store and timekeeper, and two engine cleaners. It is also desirable to have one or two improvers, who do not pay any premium, and who are willing to make themselves generally useful in order to gain experience. Where there are two improvers one of the switchmen can be dispensed with, the improvers taking turns at switchboard duty. The same staff, except, perhaps, in the boiler house, will do for a station with an output of 1,000 KW. as is necessary for one of 300 KW., as the increase necessary in the staff is not in any proportion to the increase in the output, and it will often pay better to give the men higher wages as the station increases, than to take on extra hands, an arrangement profitable alike to the employer and the employés. Where possible, it is advantageous to have some system of bonuses, so that it is to the interest of all the running staff to keep down expenses, and if it is arranged that the bonus is paid, say, three months after the end of the financial year, there is less likelihood of the men leaving, as then they always have some pecuniary interest in the place. The writer is not aware that this system is in use in many stations, but he believes it to be a thoroughly workable one, and one which it would be to the advantage of every supply station to adopt.

Repairs and Maintenance.—It has been justly said that very few stations have had a proper repairs bill up to the present, because in the case of the older stations the plant originally installed proved to be too small before it had run long enough to require any very extensive repairs, and was sold, and new plant bought, with new capital raised for extensions, and in the case of the newer stations, sufficient time has not yet elapsed since they started running for any very great wear and tear to have taken place. In every station there should be kept a repairs book, in which the shift engineer should note down any irregularity in working in any part of the station, and the engineer on the first shift should give instructions to the fitter as soon as he comes in, so that any important repairs may be attended to at once.

Every time a boiler is shut down for cleaning, the valves, fittings, &c., should be overhauled, and any defects, such as gauge cocks leaking, or safety valves blowing too soon, be attended to.

All wear in the engine brasses should be taken up as soon as it occurs, and glands and joints kept tight. Metallic packing is now very generally used, and a little attention given to the oil cups which lubricate the rods, to ensure the oil ways being kept clear, will be well bestowed, and save a good deal of wear on the packing.

In every station there should be a properly equipped repairs shop fitted with a few machine tools, where all ordinary repairs can be done by the station staff. A couple of hundred pounds spent in this way will soon pay for itself in bringing down the cost of repairs, and in the convenience of being able to have the work done in the station itself, and done at once.

Oil, Waste, and Engine Room Stores.—Contracts for each year's oil and stores should be put up for tender, although it does not by any means follow that the lowest tender should be accepted. There is no economy in getting cheap and nasty oils, packings, &c.

Cylinder oil especially should be a good high-class oil, one that has a high flash point, that will not gum, and is free from acids.

With saturated steam at a pressure not exceeding 150 lbs., vertical engines can sometimes be run very satisfactorily using only powdered black lead as a cylinder lubricant, but the higher the pressure and degree of superheat employed, the more important it is that a good cylinder oil should be used.

Grease can often be used advantageously instead of oil on many bearings, a spring plunger cup of the Kingfisher type being used.

In open type engines it is a good plan to use grease cups on small bearings, such as in the valve gear, instead of trusting to the driver oiling these parts regularly with a feeder, which he, as likely as not, will not do more than once on his shift, if then.

All the oil should be measured out for a driver when he starts his shift, and measured back when he leaves, and the amount consumed recorded together with the number of engine hours run.

In open-type engines all waste oil should be caught in drip tins, and passed through a steam filter, the filter preferably being one in which the oil is made to ascend before coming to the last chamber, thus causing a large amount of the dirt to fall by gravity into the first compartment.

In order to encourage drivers to be careful with the oil, a small bonus might be given to the most careful man, but in order to ensure against hot bearings, it would be as well to count, say, two gallons of oil against a hot bearing.

It is not very desirable to use waste in the engine room except for sopping up oil or water that may be spilt, as when waste is used in cleaning down the engines small pieces are liable to get into lubricators and oil pipes and choke them up.

A better plan is to use sponge cloths for cleaning down with, which can be collected after use, the oil squeezed out between iron rollers, and then washed for use over again, which can easily be done by having a small tank with a steam jet to boil up the water.

All stores should be kept locked up, the storeroom having plenty of shelves divided up into suitable-sized compartments, which should be labelled so that each different article has a division to itself, and is easily got at when required.

Stores should only be given out by the storekeeper, who should note down the amount used on each job.

Water.—If surface condensers are used, and not very much cylinder oil used on the engines, it is worth while to purify the condensed water and use it over again in the boilers, but *all* the oil should be taken out, and unless this can be done thoroughly, it is better to throw the water away.

Small filters are not of much use for this purpose, as they invariably soon become dirty and allow the oil to pass through into the feed tank. A filter made on the following principle would probably answer the purpose as well as any:—

The condensed water is made to rise through a tank in which is placed a cage containing coke broken small enough to pass through a 1-in. mesh, and then overflows into a tray and through several layers of coarse canvas into the feed tank.

There should be two of the coke filters, and it should be so arranged that it is an easy matter to lift the cage out of one filter and dump the coke in front of one of the boilers to be burnt whilst the water is passing through the other filter; this should be done once a day.

CURRENT SPECIFICATIONS.

LIX.—MANCHESTER HIGH TENSION PLANT.

SUMMARY.

Extent of Contract.—Supply and erection of six steam alternators, each of 1,500 KW., the supply and erection of suitable condensing plant, either surface type or ejector type, the supply and erection of auxiliary steam dynamos, and finally the supply and fixing of a number of motor alternators, as detailed below.

Type of Engines.—The main engines are to be of the vertical inverted type, either compound or triple expansion, and must have already been in successful use for driving electrical machinery of approximately the same output.

Specified Speed.—To be not less than 100 revolutions per minute.

Specified Steam Pressure.—May be either 150 lbs. or 190 lbs. per square inch, at option of successful tenderer, whose preference must be stated in tender.

Specified Overload.—20 per cent. for periods of one hour continuously, working condensing with a vacuum of 24 in.

Details of Engines.—Specification very open, but arrangements must be made for controlling the speed of any engine from the switchboard.

Specified Range of Governing.—When whole load suddenly thrown off, variation of steady speed not to exceed 3 per cent., or of momentary speed not to exceed 10 per cent.

Permissible Variation in Angular Velocity per Revolution.—This must not exceed 0·25 per cent.

Type of Condensing Plant.—May be either surface condensers with air pumps, or ejector condensers.

Capacity of Condensing Plant.—Must be capable of dealing with 315,000 lbs. of steam per hour.

Number of Condensing Units.—Six in either case, each capable of dealing with the exhaust steam of one engine.

Type of Air Pump.—"Edwards," or other approved type, to be worked preferably by electric motor, or alternatively to be steam driven.

Type of Main Generators.—To be suitable for developing three-phase currents, with star-wound armature coils having the centre connection earthed.

Specified Periodicity.—To be between 40 ~ and 60 ~ as most satisfactory for the working of the motors specified below.

Voltage of Exciting Current.—200 to 225 volts.

Normal Voltage of Alternator.—6,500 volts between conductors, or 3,760 volts between each conductor and earth.

Current in each Phase.—At normal output with non-inductive load, 133 amperes, or with an inductive load having a power factor of 0·85—157 amperes.

Specified Overload.—Same as for engines, 20 per cent. for periods of one hour.

Method of Construction.—To have rotating field magnets and stationary armature.

Specified Temperature Rise.—Not to exceed 70° F. above surrounding atmosphere after six hours' full load run in any part of armature or field magnet winding when working on non-inductive load, or 80° F. when working on inductive circuit having power factor 0·85.

Specified Range of Regulation.—With 6,500 volts on open circuit and constant speed and excitation, the voltage at full load is not to fall below 6,000 volts on non-inductive circuit or 5,300 volts with an inductive load having a power factor of 0·85.

Specified Insulation Resistance.—Not to be less than 2 Ω between the whole of the conductors, and the iron frame of the machine after continuous test at full load for six hours.

Specified Flashing Test.—13,000 volts alternating for one hour continuously between armature circuit and frame, 1,000 volts alternating between field circuit and frame.

Specified Steam Consumption.—Not to exceed 24·5 lbs. per kilowatt-hour on a non-inductive load working condensing or 30 lbs. per kilowatt-hour working non-condensing. These figures to be subject to the bonus and penalty clause mentioned below.

Capacity of Continuous Current Plant.—To be capable of developing 200 E.H.P. in addition to the power required for the motors for the condensing plant.

Specified Steam Consumption for Auxiliary Steam Dynamos.—Not to exceed 31 lbs. per kilowatt-hour, working non-condensing at most economical load.

Number of Motor-Generators.—Twenty, each to consist of 220 KW. dynamo 500 volts, driven by a three-phase high tension synchronous motor. Ten, each to consist of 220 KW. dynamo with double wound armature 205 volts each side, driven by a three-phase high tension synchronous motor as above.

Ten, each to consist of two 52-KW. direct current dynamos 205 volts, driven by a high tension three-phase induction motor.

Specified Speed of Sets.—About 400 to 450 revolutions per minute for the larger motors, and 450 to 500 revolutions per minute for the smaller sets.

Specified Overall Efficiency.—Not to be less than 87 per cent. for the larger sets and 83 per cent. for the smaller sets.

Specified Dates of Delivery.—Two large sets, two auxiliary steam dynamos, with 12 motor-generators, by April 30th, 1902, but dates for succeeding sets of plant to be stated in tender.

Bonus for Better Delivery.—One half per cent. of accepted price of the section of work concerned per week.

Penalty for Late Completion.—At same rate as for bonus, see above, for first sets, at specified rates for remaining sets.

Specified Terms of Payment.—On delivery up to 85 per cent. of contract price, 10 per cent. on taking over, remainder at end of period of maintenance.

Specified Period of Maintenance.—Probably 12 months—not expressly stated.

Stipulations as to Removal of Foremen.—Satisfactory.

Stipulations as to Wages Paid to Workmen.—Standard wages to be paid. See comments below.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tenders.—May 14th, 1901.

This is one of the most important and most interesting specifications which has been issued for some time. It has been prepared by Messrs. Kennedy & Jenkin, the consulting electrical engineers to the Corporation of Manchester, and follows on the lines adopted by the Council on the advice of their late electrical engineer, Mr. C. H. Wordingham. The problem to be solved at Manchester was by no means an easy one, for as our readers are aware, the area to be supplied embraced about 45 square miles, and power was required not only for lighting, but also for motors and tramways. The plant here specified forms the first instalment of the Stuart Street station equipment, and consists of six 1,500-KW. steam alternators, generating three-phase current at a pressure of 6,500 volts between conductors, or 3,760 volts between either conductor and the earthed centre of the system.

The specification for this portion of the work is very open; any speed above 100 revolutions per minute, which in the opinion of the tenderers is satisfactory, is permissible. The steam pressure may be either 150 lbs. per square inch if compound engines are offered, or 190 lbs. per square inch if triple expansion engines are preferred, and a steam consumption of 24·5 lbs. per KW.-hour is demanded when the set is working at its most economical load condensing, or 30 lbs. per KW.-hour exhausting to atmosphere. These figures must be guaranteed under a bonus and penalty clause of £300 per pound for every pound or fraction of a pound by which the actual results are better or worse than these figures.

It will be noticed from the summary of requirements given above that means are to be provided for controlling the speeds of all the engines from the switchboard platform.

The alternators may be designed for that periodicity which, in the opinion of the tenderer, will give best results in working, the permissible limits being 40 ~ and 60 ~.

It is open to tenderers to make offers for condensing plant of either surface or ejector condenser types, a preference being expressed for motor-driven air and circulating pumps.

The power for driving these motors, together with about 200 E.H.P. additional power required for other purposes, is to be provided by auxiliary steam dynamo plant, tenders for which are also invited.

The portion of the specification to which, perhaps, most interest attaches is that relating to the apparatus for transforming the high tension three-phase current to low tension continuous current at varying voltages. Contrary to general expectation, rotary converters are not to be employed, but motor-generators, having the three-phase motors wound suitably for the high tension current. Forty motor-generators in all are required, of which 30 are to be driven by synchronous motors, and 10 by induction motors. The operation of these machines under the working conditions specified will be closely watched, and if successful, it is possible they will help forward a reaction against that employment of rotary converters which is a noticeable feature of modern American practice, as exemplified in the Central London Railway and other traction schemes.

Delivery at an early date is of great importance, and if two complete sets of plant, with a corresponding complement of motor-generators, can be erected ready for working earlier than April 30th, 1902, the Corporation are prepared to offer a bonus of ½ per cent. per week of the value of that section, on the understanding that the contractor accepts a corresponding penalty for later deliveries than that period.

For the remaining sets dates of completion are to be given by tenderers, which they are prepared to accept under penalty of £25 per week for each steam generator, £15 per week for each condensing plant set, and £10 per week for each motor-generator set.

The general conditions are, on the whole, satisfactory. The work to be performed under the contract may be varied to the extent of 10 per cent. of the value of the whole contract, at the discretion of the Corporation acting through the engineers. This we consider thoroughly reasonable, since it enables the tenderer to calculate the risks attendant on the performance of the contract and adjust his price accordingly. The terms of payment specified above are fair, but it would be well for tenderers to limit to, say, 12 months, the period of maintenance which, though referred to, is not explicitly stated.

We have an unlimited arbitration clause, any dispute being referred to the decision of the President of the Institution of Civil Engineers or some member of that Institution nominated by him.

The successful tenderer must declare that he pays to his workpeople the regular standard rates of wages current in the district in which the work is carried out, and if there is any breach of this stipulation, power is reserved to the Corporation, acting through the Town Clerk, to pay the difference in the rates of wages actually paid and those payable under the stipulation, deducting the sum thus disbursed from the sums payable under the contract. If after this course has been adopted the contractor still pays wages lower than standard rates, the contract may be determined by the Corporation without any liability on their part to the contractor for any losses he may sustain by reason of such determination of the contract.

DRIVING BY ELECTRICITY.

He would be a rash man who declared that the progress made in this country in the application of electricity to driving machinery was not a considerable one, for there is ample evidence to show that there are some among our manufacturers and power users who have had sufficient courage and foresight to substitute electrical methods for other systems. Moreover, the most cursory examination of electricity works accounts will demonstrate that motors are being largely employed, presumably in smaller industries. It may be that one is impatient of results, but notwithstanding the numerous applications of electrical driving there is, generally speaking, a singular apathy exhibited by the average power user towards electrical systems. It is quite true that electrical driving has been urged in directions where it could not possibly show any economy. On the other hand, there are hundreds of instances where electricity might be used with the most beneficial results if one could overcome the *vis inertiæ* of the owners and proprietors of works where power is necessary.

This general disregard of possible economies is not confined to any one class, and from the largest users of machinery to the smallest there is the same disinclination to adopt electrical motors, even where it has been clearly shown that the saving would more than justify the outlay. To some extent the neglect of newer methods arises from the inherited prejudice of the average British manufacturer against interference with the coal bill; yet it is not because the question of the cost of fuel is not constantly brought before them, for during the last two years complaints have been rife as to the price power users were called upon to pay for steam coal. We are afraid many people look at the cost of a ton of coal rather than to the most efficient way of using it. There are particular industries which have fairly groaned under the enhanced prices of fuel. We have one special industry in mind at the moment where the increased price of coal shook many a concern to its base, and in more than one case resulted in bankruptcy. Yet in this very industry some remarkable results had been obtained in electrical driving, and though the figures were carefully circulated amongst nearly every member of this particular industry, there was hardly one who evinced sufficient interest in the matter to consider the use of motors for his own factory. We suppose that the continuous missionary efforts of the engineer will at length prevail, but it is distinctly uphill work. It was thought that when public supply works were able to cheapen the supply of electricity for motor power purposes, the small users would rush in a compact body to be connected to the mains. The rush has not taken place yet, and incessant canvassing on the part of electrical contractors does not bring much reward.

It is not difficult to convince the small power user that it is better and cheaper for him to use an electric motor in place of his present system, but to convince him is quite a different thing to selling him a motor.

It has been said that the initial cost of electric motors stands rather in the way of many small users, but it is not necessary for him to even purchase a motor outright. There is hardly any supply concern which is not ready and willing to hire out electric machinery, but apparently even that is not sufficient to persuade the small power user to adopt a clean and economical method of driving his machinery. Curiously enough, there is not a great deal of information regarding the financial results of substituting electric driving for other methods in this country, and we see figures which did duty several years ago still being utilised to dazzle the potential user of electrical machinery.

We know for a fact that there is an abundance of useful data among manufacturers and contractors, but, generally speaking, they carefully hug this information to their bosoms, although the publication of such information might tend to improve things all round.

It is not surprising, therefore, that we have to go to American sources for a good deal of our information regarding the results of electrical driving, and it will be useful to select two or three instances from recent issues of our American contemporaries to demonstrate the directions in which electrical driving is tending in the States. An interesting application of a polyphase distributing plant is in the Great Northern Elevator Works in West Superior, Wis. The company has already had experience in using electricity for grain elevators, and at Buffalo power is obtained from the Niagara system for this purpose. In the case of West Superior, however, special generating plant has been laid down for operating the elevating machinery for two works, and it is noteworthy that in the latter case a frequency of 60 cycles per second has been adopted, against the 25 cycles in the Buffalo system, three-phase plant being employed in both cases. It is necessary in grain elevators to sub-divide the buildings, and, as a rule, they are located at some distance from each other in order to minimise the fire risk. Two elevators are at present owned by the company in West Superior, one with a capacity of 1,800,000 bushels, and the other with a capacity of 1,500,000 bushels. Both of these are wooden buildings. A new steel elevator, with a capacity of some 3,000,000 bushels, is now under construction, and the electric plant has been put down with a capacity sufficient to drive the whole of the machinery for the three buildings.

The two existing elevators were originally driven by their own steam plant, and as it frequently happened that only a portion of the elevator was in operation, the engines were in consequence under loaded. By the adoption of electric plant for the whole of the elevators a much better load factor is obtained. Moreover, the power plant can be removed to a sufficient distance from any of the elevators to prevent the spread of fire from it to them, whereas with a mechanical drive each power house is usually adjacent to an elevator. The plant which has been erected is very complete, the engine room having an overhead travelling crane, a central condensing equipment and air pump being installed. The present plant includes a 300-KW. 60-cycle three-phase alternator coupled to a Buckeye cross-compound horizontal engine running at 130 revolutions per minute. A new generating set of 410 KW. capacity is being erected, and these generators will be run in parallel with each other. Three-phase motors are used throughout the elevators, and it is claimed that these, on account of their sparkless operation, are essential in such dusty and combustible surroundings. The motors are, as a rule, of considerable size, the larger ones having a capacity of 75 H.P. These drive the long vertical belts with buckets, which raise the grain from the lower to the upper floors of the elevator. This, of course, is the principal use of the motors, but smaller ones are employed for driving cleaners and centrifugal fans. The speed of most elevating machinery is, as a rule, so low, that a double reduction gear of some kind is usually necessary with high speed induction motors. The reducing gear adopted in this case is a raw hide combination on the motor shaft meshing with the steel teeth gear, which in turn delivers the power to a belt. It should be mentioned that the voltage at which the motors work is 440.

As instancing the diverse uses to which electric driving has been adapted, we may mention the work which has been carried out at the large packing establishments of Swift and Co., of Chicago, a packing house being synonymous with the slaughtering, refrigerating, and packing of meat. The Chicago establishment of this company covers 40 acres, and many of the buildings are several stories in height. It is obvious that an electric transmission scheme could be utilised with considerable advantages under such conditions, and this is proved by the fact that there were 13 separate steam plants, 11 of which are dispensed with by the adoption of a common generating plant.

A very complete system has been adopted both as regards the steam raising and the electric plant, a good deal being made of the fact that the adoption of automatic stokers has rendered the plant practically smokeless, which in the words of the *American Electrician*, forms an object-lesson for less progressive establishments. There is nothing, however, unusual in the generating plant, which consist of two 600-KW. generators driven by cross-compound Corliss engines. The voltage at which the generators develop current is 250, and there is therefore no necessity to provide transforming apparatus. The plant has connected to it about 1,800 H.P. in motors, 10,500 incandescent lamps, and 150 arc lamps. The motors are used for various purposes, among the more important being the

operation of conveyers and elevators. The motors are of constant speed type, and as our contemporary observes, no success has been made of this company's (the General Electric) attempt to secure variable speed polyphase motors.

The switchboard which controls the motor power and lighting circuits is interesting, but probably a little complicated.

Synchronising voltmeters are employed, and a notable feature in the installation is the extensive use of enclosed alternating current series arc lamps. The arc lighting is done through the medium of transformers, which are ordinary constant potential apparatus, built by the Wagner Manufacturing Company. From each of the three 30-KW. transformers there are two arc circuits, each circuit having a Manhattan regulator for maintaining constant current with varying lights. The principle of this regulation is that of a counterbalanced solenoid in the circuit to be regulated, which is drawn down a varying distance through an iron core as the number of lamps in circuit varies. Two circuits are run in parallel off each transformer, and no circuit includes more than 20 lamps. The current is 6·8 amperes.

An arc circuit plugboard is provided for the arc circuits, so that when only a few lights are in use they can be put on one transformer, thus avoiding the underloading of any transformer. Another packing plant of the same company is driven and supplied with light from a two-phase plant, and though there appears to be nothing unusual in the arrangement, it is interesting to quote from our contemporary to the effect that during the day when there is enough power in use to give an economical load to one or two generators, it is desirable to run the lights separately on one generator to avoid the fluctuations caused by the power circuits. In some cases the motors are driving freight elevators which are operated through a friction clutch, the motor running constantly, which may be very fairly stated to be a distinct drawback. In other cases where the motor is started and stopped with the elevator they are 15 H.P. machines built for heavy temporary overload, and take 36 H.P. at the moment of starting.

Quite a different type of machinery has been employed at the Curtis Publishing Company, Philadelphia, which is stated to be one of the largest publishing houses in the States. In this case direct current has been employed throughout the works, and a notable feature is that the motors which are utilised for driving the class of machinery common to printing establishments, are of the open type, which is somewhat refreshing after the edicts of the British Fire Offices regarding the use of direct-current motors.

The generating plant is of a very complete character, and is designed to furnish light, heat and power to such buildings. It consists primarily of a three-unit plant, any two units being large enough to take the maximum load, leaving the third idle for any emergency. Curiously enough, the advantages of a Green's economiser are again dilated upon in the description of this installation, which, by the way, appears in a recent issue of the New York *Electrical Review*.

The three larger units consist of a horizontal compound engine connected to a 200-KW. 250-volt generator. In order to use the exhaust steam for heating, and at the same time to get the economy of compounding, a system of vacuum return was necessary to avoid a back pressure on the low pressure cylinder. For this purpose the Webster system has been selected, and the exhaust steam gauge is stated to record not more than a $\frac{1}{4}$ lb. We believe this system is used in one or two places in London with equally satisfactory results. The motors are employed to drive rotary presses, folding machines, job presses, paper cutters, and all other machinery necessary in a large printing and book-binding establishment. In such work the chief feature of electric driving is the method of control, and in this case each press motor is provided with two controllers each made of special cylindrical design with crank handles on the top, similar to a street-car controller.

One of these is utilised when making up or starting slowly, and is not in use for more than a few seconds at a time, the resistance in the controller not being designed to carry full current indefinitely. This is used to bring the motor up to about half speed, at which point the resistance is cut out of circuit. For the regular operation of the press the particular speed required under varying conditions is obtained from the second controller, which is a special rheostat in the shunt field, and thus, by increasing or decreasing the saturation in the field, the speed is varied. Although this is an economical method of control, there is not any great variation presumably obtainable within economical limits, and where a greater range is required a compound form of controller is used with the resistance in series with the armature for the lower speeds, and shunt field controller for the higher. It would be interesting in such a case to know the average working efficiency of such a motor. We are inclined to think that in printing work it might be seriously affected. It will suffice to conclude this article by referring to the cost per kilowatt-hour in order to compare it with that of a public supply. It is stated that the net cost, including taxes, insurance, interest, depreciation, repairs, &c., is 1·49 cents per kilowatt-hour, and the lowest price obtainable from the local electric company was 4 cents per horse-power.

NOTES ON METER TESTING.

By ARTHUR T. SMITH, A.M.I.E.E., Chief Assistant, Bury Electricity Works.

It is surprising what little attention is often paid to this most important branch of central station working, especially in the smaller stations. Meters are ordered, and delivered by the makers, and are put on one side until needed; possibly one is tried to see if it will start, and it is put in circuit with an 8 or 16-C.P. lamp. If it starts well and good, the meter goes out; if it will not start, then it is often put on one side for a further consideration later on. To err is human; certainly electricity meter makers are sometimes very human, and it is advisable to test the accuracy of the little slip of paper which is often inserted in the meter and called the "Certificate of Test."

In many stations it would not pay to employ a man solely for meter testing, and it therefore devolves on one of the assistants. And it is this point which is often the cause of the neglect, as each assistant depends on the other, and neither, as a rule, knows what the other has already done. To obviate this, one assistant in a station should thoroughly understand the meters and testing, and not only know how to test a meter, but have a thorough theoretical knowledge of the principles of the meters used on that station. It is, of course, useless to expect a man to know every type of meter made, and hence even in the meter department uniformity of type is advisable; as few types of meter should be used as possible, not only for this reason, but because the spares and duplicate parts to be kept in stock are considerably reduced.

I will give below a few hints as to the testing of meters, and will take the Chamberlain & Hookham meter as an example. I will certainly give this firm credit for care in their testing, and for their fair dealing in the matter of complaints and inaccuracies. It is satisfactory to know that the difficulty which the makers of this meter at one time experienced with regard to the amalgamation of the armature is now entirely overcome, and I am anticipating no trouble with it in the future. It is sometimes necessary to renew the armature, owing to its being burnt up through a short circuit, or from some other accident damaging it in any way. A little care is necessary in removing the armature and replacing with another.

The mercury should be removed and the meter taken out of the case, then inverted, and the four screws removed from the plate holding the pivot and the iron bridge piece. (It is advisable always to unscrew the pivot first to prevent any accident to it.) If now the spindle be examined, two small file cuts will be noticed, one on the spindle, and the other on the collar of the brake disc, this denotes the way which the little taper pin draws out, and this should be remembered in replacing the pin in another brake and spindle. When the pin is withdrawn the armature and spindle will draw out and leave the disc. On the meter being put together again and filled with mercury, it sometimes happens that an air bubble lodges under the armature, this must be removed or

the meter will not start easily, but it is easily got rid of by tilting the meter and revolving the disc. Before putting in a new armature care must be taken to scrape and thoroughly amalgamate the edge.

To test the meter for accuracy the handiest measuring instrument is a shunted ammeter and a set of shunts by the Weston Company, as with this instrument it is possible to measure currents from ·01 ampere to 150 amperes, which gives a range sufficient for all ordinary purposes. It is the best plan to have the shunts mounted on a slate with a switch which throws each shunt in as required without breaking the circuit. The current must be capable of being varied, and this is most readily accomplished by sets of lamps and a resistance for fine adjustments. A booster may be used for higher currents than 10 to 15 amperes. The meters to be tested are all put in series, and I find it handy to put a slip of paper before each one with the number and capacity with any other items which may be needed, such as the testing currents, the constants obtained, &c., the results being finally entered in a book kept for the purpose.

The meters are first tested for starting, and the lowest current at which each starts is noted. With a 5-ampere meter the testing currents may be 1, 2·5, and 5 amperes, and start with ·2 ampere or under. In each meter there is a small label on which is written the testing constant, which is "The figure that should be always obtained by multiplying the number of amperes passing through the meter by the number of seconds (or fraction of a second) occupied by one revolution." In practice it is advisable to take 10 times as many revolutions as the number of amperes passing through the meter. For example, testing with 1 ampere, count 10 revolutions, and the number of seconds on the stop-watch ought to agree with the value of the constant, that is, with the figures; the decimal point, of course, would be wrong, but that is not needed. With 2·5 amperes count 25 revolutions, and so on. By this means all calculations are avoided, as the constant may be read directly off the watch. Below is an example of an actual test as entered up in the station test book.

No. of meter.	Size.	Current.	True constant.	Constant obtained.	Per cent. inaccy.	Starting current.	Remarks.
21,732	5	1	4·67	4·64	·6 +	·2	Meter brought in. Dirt under brake disc.
		2·5	„	4·68	·2 −		
		5	„	4·70	·6 −		

If the meter is too fast on all loads it may be adjusted by slightly lowering the four brake poles above the Foucault brake disc, and by raising the poles away from the disc the speed may be increased. It may happen, however, that the meter has not the same percentage accuracy throughout the range, and may be slow at top load. This may be altered by giving the series coil more effect by inserting a small paper or thin fibre washer between the yoke which is in front of the meter, but if the reverse be the case and the meter is fast at top load, then the washer must be inserted between the back yoke. This weakens the action of the series coils and reduces the speed on top loads.

The 2½-ampere meter which this firm has brought out is a useful size, and especially as the price is lower it will bring down the cost of small consumers. These meters are sent out with the mercury separate, and it is absolutely important that they should be filled immediately on arrival or oxidisation of the edge of the armature may take place and the accuracy of the meter be impaired.

The Bastian meter is a useful meter where the consumption with small currents is to be measured. To test this meter no current need be used, as all that is necessary is to calibrate the capacity of the tube containing the electrolyte.

Whatever the type of meter to be tested, accuracy and a methodical way of working are absolutely essential, and experience alone will reveal all the short cuts. I have written these few and brief notes in the hope that they will be of use to some, and that they will also raise the interest taken in this often neglected department of electrical undertakings.

ELECTRIC LIGHTING REGULATIONS.

The Board of Trade, after consideration of the representations made at the recent inquiry held at the Westminster Town Hall with respect to the regulations made by them under the Electric Lighting Acts for ensuring a proper and sufficient supply of electrical energy, have decided to make further regulations in the following form amending those previously made :—

Regulations made by the Board of Trade for Ensuring a Proper and Sufficient Supply of Electrical Energy.

Principal Regulations.—1. In these regulations the expression "principal regulations" means the regulations for ensuring a proper and sufficient supply of electrical energy made by the Board of Trade under the Order, , and referred to in the letter from the Board of Trade to of the day of

Amendment of Regulation 5 of Principal Regulations.—2. Regulation 5 of the principal regulations shall be read as if the following provision were added at the end thereof:—

"Provided that so long as effect is given to the next following regulation the undertakers shall not be bound under this regulation or any regulation corresponding thereto previously made to comply with any condition which has been or may be imposed thereunder, the effect of which is to prohibit any change in the pressure of the supply to any premises except with the consent of the consumer."

Amendment of Regulation 6 of Principal Regulations.—3. Regulation 6 of the principal regulations shall be read as if the following provision were added at the end thereof:—

"But where the consumer withholds his consent after the undertakers have offered to comply with the general terms and conditions imposed by the Board of Trade (County Council, local authority), and if not required to do so under those terms and conditions, also to pay the reasonable cost of or incidental to the change (including compensation for any loss or damage incurred in consequence of the change), the undertakers may appeal to the Board of Trade, and that Board may, if they think fit, give their consent to the change on such terms and conditions as they impose, and the consent of the Board so given shall for the purpose of this regulation have the same effect as the consent of the consumer."

The Board of Trade may, if they think it necessary in any case, refer to a single arbitrator appointed by them to determine what terms and conditions it would be proper to impose under this provision in case the consent of the Board is given.

Any such arbitration shall be subject to the like provisions as an arbitration in pursuance of a special Act under Part I. of the Board of Trade Arbitrations, &c., Act, 1874, and shall also be subject to the provisions of the Arbitration Act, 1889, as if the arbitration were pursuant to a submission, except that the powers under the last-mentioned Act with respect to the costs of the reference and award shall be exercised by the Board of Trade instead of by the Arbitrator.

Made by the Board of Trade this day of

Assistant Secretary, Board of Trade.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be as brief and concise as possible. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Idris" writes:—"An owner of freehold mountain land has water-power (the source of the streams being his) which he wants to use for supplying electric current to an adjoining owner of freehold land, there being only a private lane, which is open to the public as a footpath only, on either property.

"1. Can the first-named owner or his nominees convey overhead bare high pressure three-phase cables (not suspended from steel cables) to a transformer on the other owner's property, and sell current to him without any interference from the Board of Trade?

"2. When transformed down, the current would be conveyed (on overhead cables) to property which the second-named owner is building, and would cross a high road under the control of the District Council, which favours the scheme, and will give every assistance.

"The Parish Council also favours the scheme, and is prepared to buy a small amount of current for public lighting with incandescent lamps, and also will offer no opposition to the owner of the power or his nominees applying for a provisional order when the demand warrants such a step. Can the owner of power sell current to this Parish Council without a license or provisional order under such conditions?

"3. Further, can he make it a condition of supplying water for

domestic purposes to the District Council that the Parish Council shall take current for lighting?"

*** With regard to the first query put by our correspondent, we cannot see any objection, legal or otherwise, to the scheme which he proposes. Electricity, like gas or water, is a marketable commodity which the lucky owner of water power is entitled to manufacture and sell to his neighbours. It does not seem to us that any objection could be taken to the suspension of uninsulated cables over the footway in question, for even assuming that the public have a right of way along such path, neither the public nor the local authority on their behalf could take objection to the overhead wires. Were it proposed to physically obstruct the path the case would be different.

2. With regard to "Idris's" second question, there appears to be no objection to the overhead cables crossing the public road, in view of the fact that the District Council and the Parish Council have not only assented to the scheme, but are offering our correspondent every assistance. On this point, however, it should be observed that liability for accidents which arise owing to the breaking of such wires may fall upon the owner thereof.

It is also necessary to point out with reference to the erection of cables across, or under streets, in pursuance of some scheme which is not sanctioned by provisional order or special Act, that by Sec. 4 (1) of the Electric Lighting Act, it is provided as follows:—

"Where, in any case, any electric line or other work may have been laid . . . . over or across any street (which includes highway) for the purpose of supplying electricity, or where any electric line or work so laid down or erected may be used for such purpose, otherwise than under and subject to the provisions of a license, order, or special Act, the Board of Trade may, if they think fit, by notice in writing, require that such electric lines shall be used only in accordance with such conditions and subject to such regulations for public safety as may be prescribed." Having these provisions in mind, we have always recommended persons in the position of our correspondent to consult the Board of Trade before erecting any wires across the highway.

We think it is competent for the Parish Council to take and pay for current. The license or provisional order would have no effect upon a bargain of that kind.

With regard to the third question addressed to us, we cannot see how the omission of the Parish Council to take current for lighting could be remedied by bringing pressure to bear on the District Council. Nevertheless, there does not seem to be anything to prevent the "undertaker" making such terms with his consumers as he may think expedient.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

7,676. "Trolley connection guide for electric traction." H. Hancock and D. Walters. April 15th.

7,687. "Printing telegraphs." E. Kinsman. April 15th.

7,701. "Improvements relating to means for controlling the trolley-arms of electric tramcars driven from overhead wires." P. D. Milloy and International Trolley Controller Company. April 15th. (Complete.)

7,702. "Improvements in or relating to dynamo-electric machines." W. S. Boult. April 15th.

7,750. "Improvements in and connected with electric safety cut-outs." W. L. King. April 16th.

7,783. "Improvements in controllers for electric motors." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) April 16th. (Complete.)

7,796. "An improvement in commutators for electric meters and the like." C. D. Abel. (La Compagnie Anonyme Continentale pour la Fabrication des Compteurs à Gaz at Autres Appareils, France.) April 16th.

7,834. "Improvements in insulators for electric conduits." K. T. Bennet and J. T. Johansson. April 16th. (Complete.)

7,848. "Improvements in or relating to the manufacture of incandescent electric lamps." P. Scharf. April 16th.

7,855. "Improvements in means or arrangements for regulating the excitation of alternating-current machines." O. T. Blathy. April 16th. (Complete).

7,867. "Electrical explosive gases." E. Bailey. April 17th.

7,868. "Improvements in safety devices or guards for use in connection with electric traction cars and the like." A. Charlesworth. April 17th.

7,873. "Improvements in electric switches." H. H. Berry, P. F. W. Simon, and E. Skinner. April 17th.

7,884. "Improvements in apparatus for cleaning and scrubbing electrotype plates." W. Dawson. April 17th.

7,885. "Improvements in electro-medical apparatus." L. Petich. April 17th.

7,935. "Improvements in or relating to the grids of secondary batteries." G. J. Gibbs. April 18th.

7,953. "Improvements in surface-contact electric traction." J. Hines. April 18th.

7,955. "Improvements in or relating to fluid pressure thermo-dynamic engines." J. T. Wainwright. April 18th.

7,958. "Novel or improved means for working or controlling semaphore or other signalling or indicating apparatus in connection with electric tramway systems by means of the trolley-pole also applicable for other purposes." J. Wilkinson. April 18th

7,959. "Increasing the economical efficiency of electric incandescent lamps." E. Bushe. April 18th. (Complete.)

7,966. "Improvements in or relating to electro-pneumatic controlling systems." E. R. Hill. (Date applied for under Patents, &c., Act, 1889, Sec. 103, September 20th, 1900, being date of application in United States.) April 18th.

8,015. "A direct acting combined magnetic regulator and brake for electric arc lamps." J. Lenderyou and T. S. M. Wyatt. April 18th. (Complete.)

8,102 "Improvements in switch systems for telephone circuits." L. Cerebotani and C. Moradelli. April 19th. (Complete.)

8,110. "Improvements in means for facilitating the installation and control of electric lighting and like apparatus." H. T. Harrison. April 19th.

8,128. "An improved section or feeder pillar or box for electric cables." G. Hill. April 20th.

8,162. "Improvements in and relating to electrical lamps." V. I. Ferny. (Allegemeine Elektricitäts Gesellschaft, Germany.) April 20th. (Complete.)

8,196. "Improvements in sockets or holders for incandescent electric lamps." J. W. H. Uytenbogaart. April 20th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

13,074. "Improvements in apparatus for electrolysis." P. Schoop. Dated June 23rd, 1899. Electrodes, hypochlorites, &c., obtaining. Relates to apparatus for electrolysing liquids, especially alkaline chlorides, without a diaphragm. The solution is led to one end of an upper trough, and overflows from its opposite end to the next below, and so on to the bottom. The bottom trough is connected to the positive conductor, and the upper to the negative, and as each trough dips slightly, or a flange thereon dips slightly, into the liquid in the next lower trough, and as there is only electrical communication through the solution, each trough becomes an anode on its upper surface, while the small part dipping into the liquid in the next lower trough becomes a cathode. The polarity may be reversed when it is desired to give the cathode the larger surface for reducing purposes, such as for reducing nitrophenol to amidophenol. The double electrode may be formed of metal, graphite, &c. In a modified form, the troughs are arranged in an inclined plane, the liquid passing from one trough to the next by a connecting pipe arranged alternately at opposite ends, and each trough having a portion which dips over into the liquid in the next lower trough. Slots are cut out of this bent-over portion to allow of the escape of gas. In another form the troughs are all on the same level and each one receives an independent supply of liquid. Two or more batches of such troughs may be connected together at different levels. 5 claims.

13,088. "Improvements in electric tramways or railways on a road contact system." B. J. B. Mills. (E. Bonnet, J. Paufique and G. Liniers.) Dated June 23rd, 1899. Electric railways and tramways on a road contact system with switches worked by magnets on the vehicle. Collectors, switches.—The magnetized bar which throws the switches and picks up current, is excited by current from a battery and also by the motor current when the vehicle is running. The two currents flow through separate coils which may be placed on vertical or horizontal cores. To improve the magnetic circuit, additional magnetized bars on the vehicle pass over vehicles extending from the ring which carries the switch plunger and these wings may be embedded in, but insulated from, blocks of magnetisable material. The ends of the bars may be of non-magnetic material, so that the plunger is dropped before contact with the road stud is terminated. 5 claims.

13,105. "Improvements in electric arc lamps." The Jandus Arc Lamp and Electric Company, Limited, and A. B. Jones. Dated June 23rd, 1899. Arc lamps. An arc-enclosing cylinder made with a contracted neck and a larger top opening, is secured by a flared tube bearing upon the inside of the neck and screwing into a socket which is made with an annular channel to receive an asbestos washer and the ground end of the cylinder. The socket screws on the lower carbon holder. The cylinder carries an iron cover fitting closely to the upper carbon, and provided with a tubular extension of somewhat larger bore, fitting loosely in a cylindrical aperture in a fixed part of the lamp. In a modified form of cover, the upper end of the tubular extension fits the carbon, its bore being conical with the larger end downward. 5 claims.

13,111. "Improvements in and connected with electrical switches." E. J. Wade and The Electric Motive Power Company, Limited. Dated June 24th, 1899. Switches adapted for controlling the combination of storage batteries, being an improvement upon the invention described in Specification No. 11,525, A.D. 1898. The terminals of the cells are connected to two rows of contacts. These contacts run on the surface of a drum fitted with suitable contacts and cross connections. Rings are embedded in the drum, and are connected to contacts of suitable configuration to produce the desired series and parallel arrangements. 3 claims.

13,125. "An improved apparatus for registering the output of electric light and power stations, and for like purposes." F. W. Martin and C. A. Colville. Dated June 24th, 1899. The apparatus is more especially for producing arrows showing the output of electric lighting and power stations, and forming a check on the switchboard attendant. A roller with spring pressure rollers draws a strip of paper from a roller, the roller being driven from a clock. Pens are carried by arms which can be traversed by parallel screws on turning hand-wheels. The pens are set so that the indicators show the volts and amperes on scales, and then trace lines on the paper in differently-coloured inks. 2 claims.

13,136. "Appliance for telephone pay stations." J. E. Kingsbury. (The Western Electric Company.) Dated June 24th, 1899. Relates to systems of telephones in which a calling subscriber pays for each conversation at the time of calling, the coin being returned if the required connection is not obtained. At the subscriber's station a coin shute is arranged with a releasing magnet and armature, and also contact springs by which an earth circuit is closed on the insertion of a coin. A pivotted portion of the shute allows the coin to be returned and to signal the same. The subscriber's bell is bridged across the lines and includes in the bridge a condenser. The exchange is arranged with shunt controlled lamp signals, and has a reversed battery put to line by the key for operating the polarised magnet on the completion of a call. 5 claims.

13,174. "Improvements in electric signalling apparatus." F. B. Herzog. Dated June 24th, 1899. Relates to improvements on the electrolytic annunciators described in Specification No. 1,901, A.D. 1896, and more generally to the combined use of such annunciators, which give a transient indication with others of the electro-magnetic type, in which the indication continues until the apparatus is reset by some manual operation. This combination is applicable for telephone central apparatus, and the electrolytic annunciator of each line may be connected either in series or in parallel with the corresponding electro-magnetic annunciator. In the electrolytic annunciator the electrodes are mounted in a hollow base, preferably of opal glass, which is immersed in the solution of potassium iodide, &c., contained in the jar. The jar is connected to the base by the screw or other cap with a washer interposed between them, and the base is hung by the pin on the elbow piece from the arm of the support so that the jar, which is normally held against the support by a screw, &c., can be swung outwards for inspection or repair of the parts, &c. The support is adapted to be fixed to a table or wall, &c., and the wires from the electrodes are connected to the leading-in wires through the junction board. The single negative electrode is connected to the common return wire. The wire from each electrode passes through a soft rubber plug in the wall of the base. By providing a convexed backing of vulcanite or hard rubber for each electrode, the latter can be made of platinum foil. In one arrangement a tube connected to an elastic bulb is provided for blowing air through the electrolyte to remove the indications, the bulb being formed with a number of perforations to prevent backward suction. A vent tube is provided for the escape of the air from the jar. A wire projecting out from below and extending upwards between the electrodes may be substituted for the negative electrode. The base is filled up with a cement, preferably of wax and resin, to protect the wires, &c. The indications may be placed on a plate mounted on the base, preferably to read alter-

nately with the electrodes on either side. To aid in retaining the iodine stain in the electrodes, and to protect it from gas bubbles, &c., the electrodes may be set in recesses in the base, or in suitable perforations in a separate plate. In lieu of effecting the indicat ons by a stain of iodine, &c., they may be given by the appearance of gas bubbles on a black background, which may be formed of black silk, &c., arranged to cover the electrodes either singly or collectively. In this case the electrolyte may consist of a saline solution, &c., containing gum arabic. Instead of employing the air blower, the jar may be mounted so that it can be lifted up and shaken to dissipate the stain, &c. The base may also be replaced by somewhat different arrangements. 15 claims.

13,194. "Improved methods of winding coils for continuous current dynamo and motor electric machines." A. W. Tomkins. Dated June 26th, 1899. Armatures. A coil for continuous current dynamos and motors is made by winding the wire round pins or projections fixed to a board or plate. The convolutions are secured together by a pair of clamps and the coil is then taped. Finally, it is transferred to a vice or clamp, in which first one end and then the other is bent to the shape of the drum on which it is to be placed. 2 claims.

13,226. "Improved construction or arrangement of appliances for underground or conduit traction by electricity." J. H. Rose. Dated June 26th, 1899. Electric railways and tramways on the conduit system. Conduits, collectors. The slotted conduit is built up of trough sections and removable cover sections carrying paving blocks and secured by bolts or lugs and brackets. Tubular rails in the conduit convey steam, hot air, or water to dry it, and they support the section or other section conductors by means of insulators. The collecting sloes are carried by the arms on the shank. This shank or a separate support carries segmental scapers or brushes for sweeping out the conduit, and also a fan or other means for disturbing the dust. 2 claims.

13,230. "Apparatus for supporting pendant globes applicable to the globes of enclosed arc lamps." T. I. Soderlund and O. A. Ekvall. Dated June 26th, 1899. Globes and holders therefor applicable for enclosed arc electric lamps and for other purposes. Two or more hooks pivotted on fixed parts of the lamp have limited movement, so that a globe can be pushed up over them and its neck then rests on their out-turned ends. A cover sliding on the fixed parts normally rests on the top of the globe, but carries loops, hooks or the like to engage the hooks and turn them inward if the globe and cover are raised; if the cover is then held up by hand, the globe can be removed. The hooks may otherwise be placed outside the globe. 2 claims.

13,233. "Improvements in apparatus for periodically producing electric currents by wind power." M. Gehre. Dated June 26th, 1899. Dynamos, driving apparatus for periodically producing electric currents by wind power, more particularly for charging accumulators. A wind motor operates by means of links the oscillating lever of a rachet mechanism comprising a rachet wheel, a driving pawl and a stop pawl. The ratchet mechanism serves to wind up a weight, or it may be a spring, until by the action of a stud on a catch a weighted lever comes into play and causes the disengagement of the pawls. Rotation is then set up in the opposite direction, and the motion is transmitted by a spur wheel and pinion to the dynamo shaft. In one course a second stud on the ratchet wheel causes the re-engagement of the pawls therewith. 1 claim.

13,256. "Improved means of lessoning the danger attendant upon the employment of overhead conductors in electric tramways." M. H. Smith. Dated June 27th, 1899. Electric railways and tramways with overhead conductors arranged in sections, which are cut out of circuit in case of breakage, &c. Conductors, switches.—Sections of the overhead conductor are connected to the main at one end through a wire, fuse, switch arm, and thick coil on the electro-magnet, and also through the thin coil on the magnet. At the other end the section is connected to earth or return through the wire and rheostat. In case of breakage, &c., the switch opens, owing to loss of current in the magnet coils. The ends of the trolley wire sections are carried by two insulators on a bar mounted on a span wire or arm. 3 claims.

13,257. "Improvements in connection with underground conduits for electric tramways." M. H. Smith. Dated June 27th, 1899. Electric railways and tramways on a conduit system. Conduits.—Under the conduits from which the tramway is worked is a culvert or subway, in which sewers, gas, water, compressed air and hydraulic mains and pipes, and electric conductors for power, light, telephones, &c., are placed. The roadway is carried by girders and arches. A service truck driven by electricity runs on rails in the subway. Reference is made to Specification No. 5,025, A.D. 1894. 1 claim.

13,270. "Improvements in telephone exchange systems." D. Sinclair. Dated June 27th, 1899. Relates to improvements in telephone systems. The invention is described with reference to a diagram which is too complicated for purposes of abridgment. 2 claims.

13,271. "Improvements in telephone exchange systems." D. Sinclair. Dated June 27th, 1899. Relates to arrangements in a telephone exchange, by which fleeting signals from sub-stations are converted at the exchange to signals which last until broken by the action of the operator. A slightly modified form is described, in which the subscriber is provided with a through-calling generator and an exchange-calling key. The system is arranged with the various relays having double contacts and circuits, so arranged that the completion of the first circuit shall cause the signal lamp to light up, and the completion of the second shall cut that lamp out, the lamps being arranged in local circuits with low voltage batteries. For instance, the indicator lamp is lighted when the relay is excited by the call due to the momentary earthing of the line circuit when the telephone lever rises, the circuit being maintained closed by the exchange until the circuit of the relay is closed by the insertion of the answering plug into the jack. The plugs are arranged on the three-point branch system. The listening key is provided with extra contacts, and the ringing-up key has the lever held by the armature catch of a double-wound magnet, the coils of which are described; the plug cord contains a translator or two condensers, and impedance coils. 8 claims.

13,274. "Improvements in the manufacture of accumulators." A. Schanschieff. Dated June 27th, 1899. The plate is made of two grids of lead, the grids being cast with square holes in them, and the transverse ribs being of triangular section. The grids are placed face to face, so that the points of intersection of the ribs on one grid are opposite the centres of the holes of the other grid. The grids are kept apart either by making the outer rib or edge of greater width than the rest of the grid or by small pieces of lead, and are burnt or soldered together along their outer edges. The paste for the positive plates consists of a mixture of minium, sulphate of lead, and sulphate of ammonium. The paste for the negative plates consists of a mixture of litharge and carbonised sugar. The provisional specification states that the grid is such as is described in Specification No. 18,702, A.D. 1898. 3 claims.

13,276. "Improvements in or relating to enclosed motors or dynamos." P. Rosling and H. W. Appleby. Dated June 27th, 1899. Cooling and ventilating casings. Comprises improvements in enclosed motors or dynamos, provided with a fan or its equivalent for ventilating purposes, such as are described in Specification No. 468, A.D. 1898. To prevent the surrounding air from obtaining access to the interior of the machine, when it is at rest, the outlet in the casing is fitted with a valve which remains open while the machine is running, but closes immediately it is stopped. The outlet may be connected by a pipe with any suitable atmosphere, in which case the valve may be dispensed with. The air inlet opens into a chamber, the sides of which are formed by the fan division plate, and end cover. To prevent leakage of air from the casing into the inlet chamber the joint between the fan and division plate is formed by concentric flanges arranged in close proximity to each other, thus forming a long and narrow passage. A similar joint may be formed between the fan and the bearing case to prevent oil from being drawn in. When the motor or dynamo is coupled direct to another machine, and works in an atmosphere that is detrimental to the parts, the inlet chamber may be dispensed with. 7 claims.

13,280. "Improved in connection with channel rails and current supply for electric tramways." M. H. Smith. Dated June 27th 1899. Electric railways and tramways with conduits in which are contact studs connected permanently or during the passage of the vehicle by any suitable means. Conduits, conductors, collectors, switches:—The conduit is formed by the rail and the guard rail and studs are carried by the latter in the path of a conducting cord or rod attached to shanks projecting from the vehicle through the slot and forming the collector. The studs may be permanently connected to the main or by any mechanically-operated or any other switch arrangement. The circuit from the feeder is completed by the spring-returned plunger when the collector comes between the discs and forces the latter outwardly. The plates with the plunger may revolve. A duplicate set may be provided for the return. 5 claims.

13,424. "Improvements in electric cranes and similar revolving appliances." J. G. W. Aldridge. Dated June 28th 1899. Coupling. Concentric, superposed and insulated cylinders are fixed to the floor of the crane cabin, with which they rotate. The leads are passed through an insulating-plug and connected to ports between which are the internal surface of the rings. Contact is effected by gauze loops lined with steel bands and fitted exteriorly with copper strips. 3 claims.

13,509. "Improvements in or connected with electric cranes." J. G. W. Aldridge. Dated June 29th, 1899. In electric cranes, the switch handle is connected by links to the clutch for the hoisting drum, so that, as the motor is starting, the drum is automatically and simultaneously geared with the motor shaft. The descent of the load is regulated by a hand or other brake. 3 claims.

13,561. "Improvements in means to be employed in electric traction." M. J. Barreau. Dated June 30th, 1899. Relates to a construction of electric motors, designed to secure maximum efficiency notwithstanding variations of speed, especially applicable to electric traction, but also applicable to navigation and transmission of motive power. The windings of the induction coils are divided into sections, and by means of a rotary controlling switch these sections are variously connected into sets or groups, while the battery cells are similarly grouped, in order to give the variations of speed desired. The invention is applicable both to shunt wound and to series wound motors. 2 claims.

13,566. "Improvements in thermostatic electric current breakers." The British Thomson-Houston Company, Limited. (C. D. Haskins.) Dated June 30th, 1899. A tube containing a few drops of highly volatile liquid, such as chloroform, &c., is curved and suitably supported. Upon attaining a critical temperature the liquid volatilises, and the tube is straightened. This movement, in the case of an electric cut-out serves to release a contact arm or to close a circuit through a magnetic cut-out, &c. The contact bridge is carried by a pivoted arm connected by a link with a re-setting handle. It is held in the on position by a toggle arrangement. A pair of thermostats are supported by studs their free ends being connected by a bar resting on but insulated from the lever. The current is caused to flow through the thermostats, and should it become excessive, the tubes straighten and trip the circuit breaker. In a modified arrangement electrical connection is made with the thermostat by means of a sliding connection so that the effective length of the heating tube may be varied. 6 claims.

13,593. "Improvements in secondary batteries." D. Tommasi. Dated June 30th, 1899. (Date under International Convention, January 23rd, 1899.) The positive electrodes are each made of a strip of metal wound into a spiral between the coils of which the active material is placed. The strip may be made of antimony-lead or of steel, copper, bronze, &c., coated with lead, and the strip itself or the whole electrode is coated with collodion mixed with platinum black, cobalt peroxide, or maganese dioxide to render it unattackable by the electrolyte. The negative electrodes may be constructed similarly to the positive electrodes, or they may each consist of a flanged disc, of carbon having studs or projections on both faces and corrugations on its internal circumference. The negative electrode may also consist of a flanged disc of insulating material, each face of which is covered by a metal disc upon which the active material is spread and retained in place by non-conducting cross arms. The negative electrode may also consist of a metal disc mounted on an insulating core and encircled by a rim of insulating material or of conductive material unattackable by the electrolyte. The electrodes are all mounted on a horizontal shaft. The active material for the positive electrodes consists of lead oxide mixed with about 5 per cent. of cobalt oxide or manganese dioxide, and that for the negative electrodes consists of lead oxide or spongy lead mixed with crushed carbon or graphite. 6 claims.

13,616. "Improvements in motor electric meters, parts of which are applicable to motors and dynamos generally." Evershed & Vignoles, Limited, and S. Evershed. Dated June 30th, 1899. Motor energy meters and other motors and dynamos, having armatures with commutators are made with large rotary collectors instead of brushes, either the collectors or the commutators being flexible. In one arrangement the commutator consists of resilient wires, of iridium platinum or other metal, fixed at one end on an insulating disc on the motor shaft and parallel to the shaft. The free ends of the wires bear against gilt or platinised flanges on the edges of light metal discs supported by shafts parallel to the motor shaft; these shafts turn in metal bearings through which the current passes, each shaft having at one end a platinum iridium point and bearing. In a modification the commutator wires and collector shafts may be radial or inclined to the motor shaft. The commutator may be rigid and constructed as described in Specification No. 9,127, A.D. 1897, the collectors being cup-shaped. To compensate for residual friction in a motormeter, a small magnet or iron bar is supported so as to provide a small permanent field tending to cause the armature to rotate. The rod may be an extension of a brake magnet. To indicate the strength of the brake magnets in a motor meter a simple magnetometer is provided. This may consist of an axle carrying a small strip of iron in the field of each magnet, a counterweight or spring connection, and a long pointer near a fixed scale. The magnets hold up the iron pieces in opposition to the weight or spring, so that any change in the strength of the fields of the brake magnets is shown. By slightly weakening and strengthening the brake magnets by means of a shunt piece of iron, or a few turns of a current conductor, the meter can be calibrated and the scale marked for different strengths of the brake magnets, so that a percentage correction may be afterwards applied to the dial readings if the magnets change. 3 claims.

13,617. "Improvements in electric measuring instruments." E. C. Rimington. Dated June 30th, 1899. Current, energy, and quantity meters. A flat spring secured to a bracket moves over a scale on a base and carries a thin tapering iron core partly within a flat solenoid fixed on the base. When the instrument is used with continuous current, the solenoid may be wound on a copper bobbin, or provided with a copper lining, to damp oscillations. The solenoid may contain a fixed iron core. The instrument may be enclosed in an oil bath. In a modification the iron core is replaced by a narrow solenoid on the spring. In a further modification the springs carries a ring-shaped coil near another fixed on the base. In either modification the movable coil is of fine wire, and connected by flexible wires in parallel with the fixed coil for measuring current, or in series with the fixed coil and a resistance for measuring pressure, or the instrument may be connected as a wattmeter. Either form may be used to record on a moving surface. 2 claims.

13,646. "Improvements in electrical motive-power apparatus." T. D. Hollick. Dated July 1st, 1899. Relates to means for stopping, starting, reversing, and varying the speed of electric motors used for driving cranes, hoisting gear, and other machinery, or for electric traction. The armature and field magnets are arranged so as to rotate in opposite directions, the field magnets being supported by a sleeve on the armature spindle. In one arrangement the sleeve and spindle are connected respectively to bevel wheels, gearing with a second pair of bevel wheels free to rotate on studs carried by a frame or drum from which the power is taken, or which may itself form the hoisting barrel of a crane. When current is supplied to the motor, the field magnets and armature rotate at the same speed in opposite directions, but the gearing is such that no motion is transmitted to the pulley. If, however, the field magnets are stopped by applying a brake to the drum the armature will drive the pulley at half its own speed. Similarly the armature may be stopped by a brake acting on a drum, in which case motion in the opposite direction is derived from the field magnets. Intermediate speeds may be obtained by more or less retarding the motion of either part. Instead of bevel gearing spur wheels and pinions may be arranged so as to produce the same result. Two such arrangements are described for transmitting motion from the armature shaft to another shaft in line with it. In a modified arrangement, two motors are employed, the oppositely-rotating armatures of which are connected to the gear wheels respectively. 4 claims.

13,650. "Improvements in bonds for electric tramways and railways." W. E. Kenway. Dated July 1st, 1899. Rail bonds. Tubular or hollow bosses are formed at the ends of the bars, which may be slit, laminated, corrugated, &c. The bosses have coned surfaces where they fit together, and cylindrica surfaces where they fit into the rail web, and they are expanded or upset when fitted to the rail. The bars or bosses may be arranged to lie on the same or on opposite sides of the rail. 1 claim.